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KARL PEARSON, 1857–1936

By Raymond Pearl
Johns Hopkins University

Animo vidit, ingenio complexus est, eloquentia illuminavit. Velleius Paterculus.

I

The unrolling of the long scroll of human history has shown nothing more clearly than that the number of individuals is in total extremely small who by the sheer power of their own intellects, unaided by position or circumstance, have been able to influence appreciably the modes of human thinking. Since the beginning of recorded history the world has held a lot of intelligent and shrewd men, each doing his life's work well, who passed on in the end without leaving a discernible trace upon the rest of humanity that they had individually ever lived. Whenever human thought or outlook has altered in its course, by ever so little, it has always been because some extraordinary individual—in the literal sense of the words—has changed it, in a wider or narrower field as the case may have been. Both quantitatively and qualitatively such individuals have played a rôle in human biology analogous to that of catalyzers in chemistry. They make things go differently.

Karl Pearson was one of these extraordinary individuals. In literal truth "his intelligence saw a problem, his genius encompassed it, and his exposition illuminated it," to paraphrase what Velleius said of Cicero. Because he lived and worked virtually every branch of science, pure and applied, is different today from what it was when he began. The differences are permanent and irrevocable. Biology, anthropology, psychology, agriculture, physics, mathematics, engineering, education —to take only the more conspicuous examples—will bear in perpetuity the indelible impress of Karl Pearson's mind. His work is ended, to be

sure, while science is deathless and will continue to move on. His thumbprints on its pages will grow dimmer and be blurred with the passage of time. But he made it go a different way, and science never retraces its steps.

How came it about? In what way was such an effect produced. It was not by the route of great discovery, because Karl Pearson never made a particularly important discovery, great or small, as a review of his life work plainly shows. What he did do was the thing that Pawlow long ago said was really the most important thing a scientific man could ever do, namely to develop a new technique or methodology in some branch of science—this on the ground that substantially all the real advances in science have been the resultants of new techniques, mental or material or both. Precisely this is what Pearson did. Out of well known mathematical principles and procedures, each separately quite devoid of novelty, he constructed a new statistical calculus; made the world for the first time truly conscious that some sort of a logically coherent statistical calculus was indispensable for the sound prosecution of the enterprise of science; and demonstrated by his works that his was the best one presently at hand. The results were far-reaching in the way that has been indicated. Every stage in the progression met vigorous and sometimes bitter opposition from lesser minds, as is the normal way of mankind with new ideas of whatever sort. Pearson, being a fighting kind of man, fought for his ideas. But all his fighting, splendid as some of it was, had not the very smallest influence on the outcome, as we can now see. Humanly he wanted to see his ideas triumph. But ideas rarely if ever have really "triumphed." Theirs is not so crass a way. If they are good and useful they get *used* more and more. Just this has happened to the *corpus* of Pearsonian statistical ideas. Every college in every land teaches them. Every laboratory uses them. It would be pointless to say that Pearson's fighting was in vain; it just was unnecessary.

II

Karl Pearson was born in London, March 27, 1857, and died suddenly on April 27, 1936. His father William Pearson was a Yorkshireman, who became a distinguished barrister and King's Counsel. The Pearsons were stout folk, with an almost infinite capacity for concentrated hard work. Karl Pearson's association with University College was nearly lifelong, for as a boy he was educated at University College School, and at the early age of 27 was appointed to the Professorship of Applied Mathematics and Mechanics in the College. From then on to a few months before his death his life work was done

within the walls of University College, London, with only summer vacation interludes in the country cottage where the work went on just the same, and where the monumental "Life of Francis Galton" was mainly written.

In 1875, at the age of 18, after a year spent for reasons of health with a private tutor, Pearson entered King's College, Cambridge, as a scholar, and was graduated B.A. (Mathematical Tripos, 3rd Wrangler) in 1879. He was elected a fellow of the College the following year, and held the fellowship until 1886. It was his original intention to follow in his father's footsteps and make the law his profession. To this end he was called to the Bar in the Inner Temple in 1882. But circumstances and a rapidly developing disinclination to the practice of law as a mechanism for earning a living altered this plan, and substituted for it the academic life, for which he was so fundamentally suited.

Pearson thoroughly enjoyed his undergraduate life at Cambridge. Shortly before his death he said of it: "I want to point out that in the Old Tripos Days at Cambridge it was possible for an individual thoroughly to enjoy his undergraduate career, to read mathematics outside the Tripos range, and a good many other subjects as well, to find 'coaches' who led him on and grew to be friends, to find college authorities who on the whole had some sense of humor and were not wholly upset by his want of respect for the 'conventions,' and lastly, and best of all, to have no vampire Tripos conception hanging over him for more than three years. There was pleasure in the friendships, there was pleasure in the fights, there was pleasure in the coaches' teaching, there was pleasure in searching for new lights as well in mathematics as in philosophy and religion. I think I carried away from Cambridge my full share of the benefits it can bring to any of its sons."

Among the great men with whom he had more or less close association in the Cambridge days, and by whom his outlook in after life was in some degree influenced were Edward John Routh, perhaps the greatest mathematical "coach" Cambridge has ever seen, who trained something over 700 pupils of whom 500 in round numbers became wranglers, including the senior wranglers for the twenty-two consecutive years 1861–1882; Munro, the great classical scholar, whose edition of Lucretius is still unrivalled, and who entreated Karl Pearson "with almost the tenderness of a father to write a few Latin verses"; Stokes, the mathematical physicist and pioneer in spectrum analysis, who was in K. P.'s own mature opinion the best lecturer (with one exception, Quincke) he ever encountered; Adams, the co-discoverer of Neptune, who with K. P. constituted the sole auditors of a course of lectures on Dante, taken as a diversion from mathematical reading; Cayley, justly

regarded as one of the greatest mathematicians of all times, and certainly one of the most prolific, who served port at his Smith's Prize Examination, and remarked a few days later that "there was only one man [K. P.] who appeared to have thoroughly enjoyed his paper—it was the one man who [drank and] thoroughly enjoyed his port"; Clerk Maxwell, brilliant star in the galaxy of mathematical physics, whom Pearson, in the luncheon interval of a Smith's Prize Examination, of all inopportune times, "aroused to the highest pitch of anger" by speaking disrespectfully of Noah and his flood; and Isaac Todhunter, whose posthumous *History of the Theory of Elasticity* Pearson completed and saw through the press, chosen as a very young man for the task because of an original proof he had given in an examination paper in answer to a question on the flexure of prisms.

If Pearson thoroughly enjoyed his undergraduate days, the first few years of his fellowship with its complete freedom from any sort of responsibility or duty—including freedom to go where he pleased and do what he liked—formed a fitting climax. I still recall vividly the gleam in his eye and the joy in his face when he told me many years ago about his life in those days. Rejoicing in his liberation he first went off to Germany. "In Heidelberg I studied Physics under Quincke, but also Metaphysics under Kuno Fischer. In Berlin I studied Roman Law under Bruns and Mommsen, but attended the lectures of Du Bois Reymond on Darwinism. Back at Cambridge I worked in the engineering shops but drew up the schedule in Mittel- and Althochdeutsch for the Mediaeval Languages Tripos." But even such an exhibition of range of interest and versatility of talent is only a part of the story. The life in Germany involved more than university lectures. He lived with the people—*Bauern* as well as *Professoren*—soaking in like a blotter the fundamentals of an alien culture. At the same time he was eclectically playing with the flood of ideas welling up in a yeasty young head; ideas ranging over literature, art, philology, folk-lore, anthropology, religion, sociology, history and politics.

As tangible major products of this fellowship period, though in part actually published after its conclusion, may fairly be regarded the three books that first brought Pearson considerable public notice—*The Grammar of Science*, *The Ethic of Freethought*, and *The Chances of Death*—since in whole or in part they were the outcome of interests and activities dominant during that period.

The Grammar of Science (1892 and later editions) was a remarkable achievement, by any standards of time or place. For a generation it had a great and far-reaching influence, particularly upon young men embarking on scientific careers but also upon other alert minds. Nowa-

days it is apparently little read. The world has moved on. Some of the very characteristics of its literary structure that gave it usefulness and influence when it first appeared, and in its earlier revisions, automatically dated it and made a certain, though longish, ephemerality inevitable. But in the welter of modern physical mysticism, rapidly spreading over into biology, it will do no young man any harm to read the second edition of *The Grammar of Science*. For it taught, as its central and imperishable theme a truth that will never die and that each new generation of oncoming workers in science has to learn, that science can never explain why but only describe how.

The Ethic of Freethought and *The Chances of Death* were definitely aimed at a popular audience. Both were collections of essays, lectures, and public addresses. It is safe to say that *The Ethic of Freethought* is practically forgotten today. It contains the first fresh and more youthful boiling over of many of the ideas that K. P. later discussed in greater detail and with riper wisdom at various times and places. It was first issued in 1887, but dated 1888, and a second revised edition appeared in 1901. The book falls into three sections: Freethought; History; Sociology. It opens with the following statement: "I set out from the standpoint that the mission of Freethought is no longer to batter down old faiths; that has been long ago effectively accomplished, and I, for one, am ready to put a fence round the ruins, that they may be preserved from desecration and serve as a landmark," and then goes on to say: "the first five papers of this volume endeavour to formulate the opinions which a rational being of today may hold with regard to the physical and intellectual worlds. They advocate—with what measure of success I must leave the reader to judge—a rational enthusiasm and a rational basis of morals. They insist on the almost sacred nature of doubt, and at the same time emphasize scientific and historical study as the sole path to knowledge, the only safe guide to right action. The Freethinker's position differs to some extent from that of the Agnostic. While the latter asserts that some questions lie beyond man's power of solution, the former contents himself with the statement that on these points he does not know at present, but that, looking to the past, he can set no limit to the knowledge of the future. He has faith in the steady investigation of successive generations solving most problems, and meanwhile he will allow no myth to screen his ignorance. The Freethinker is not an Atheist, but he vigorously denies the possibility of any god hitherto put forward, because the idea of one and all of them by contradicting some law of thought involves an absurdity. He further considers that in the present state of our knowledge and of our mental development, the attempt to create

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self-consistent gods is doomed to failure. It is mere waste of intellectual energy."

Here plainly is revealed the pattern of the philosophy that motivated and guided the man's life work, in all its major features. Realistically viewed it is the expression of the complete equivalent of a religious faith; faith in the enduring virtues and values of science, of history, of scepticism, and of curiosity—the desire to know—as wellsprings of revelation for the conduct and meaning of human life. This way of putting the matter is not mere rhetoric. Spiritually there is an extremely close and deep-rooted parallelism between the manner in which Karl Pearson actually conducted his own life and the way that a few persons of really great and abiding religious faith lived theirs.

In *The Chances of Death and Other Studies in Evolution* published in 1897 the statistician first emerges to public view. The basic significance of this book in marking a point in its author's development seems to me to be two-fold. In the first place the Cambridge mathematical training is put to useful work. The rich intellectual pudding that has been in the confecting all these years has jelled into the general pattern that is to be dominant to the end. In the second place, an additional major tenet of the author's faith makes its now well-considered appearance. "He believes that the sympathetic reader will find in one and all the essays the fundamental note of the author's thought, namely: the endeavour to see all phenomena, physical and social, as a connected growth, and describe them as such in the briefest formula possible. Without asserting that evolution can explain anything, but accepting it as a most invaluable formula for describing the sequences of phenomena as we have experience of them, the rationalist has at present a quite impregnable stronghold against reactionaries of every type. He is not called upon to show that evolution explains the universe; he may content himself with the simple challenge to his critics to produce any other formula so useful in describing our experience of the concatenation of phenomena—any other formula which so markedly economizes thought, or, differently expressed, which so amply fulfills the purport of science."

The Chances of Death appeared while I was an undergraduate in college. Heterogeneous as it really is in content, in spite of K. P.'s earnest if not wholly convincing plea of unity, it stirred my imagination and enthusiasm as nothing ever had that I had read up to that time. It plainly was not a great book in the sense that *The Origin of Species* was great. But it *was* great in another way. It was alive, hearty, vigorous. It was about a lot of things you could do something about. It in-

spired curiosity and action, rather than awe. To a callow budding biologist, very young and very ignorant, it opened enchanting vistas of possibilities in biological thinking and research before undreamed of. It was wonderful. And as presently became apparent the Dartmouth sophomore was not the only one who had seen the vision and been stirred by what Karl Pearson was up to. Biometry had in fact been born, and was yelling and kicking as a lusty infant should.

III

In the technical journal of an association of professional statisticians it would plainly be supererogation to attempt to review in any detail the great volume of Karl Pearson's statistical contributions. In fact even such a possibility is precluded because in mere bulk they are unparalleled in the history of this branch of science. The old quill pens on the study and office desks—relics of Inner Temple habituation to be occasionally but never wholly succeeded in later years by a very soft nibbed fountain pen—scratched out a prodigious number of words and figures in that characteristically forceful and clear if not exactly beautiful long-hand. Naturally some of these papers were more important than others. Some had mistakes in them. But with whatever shortcomings that there may have been duly entered in the ledger, on the balance few men who have filled so many pages in the story of science have left so clean, so worthy, and so honorable a record.

Technically Pearson's most important contributions to *statistical theory* fall in four categories. They are:

1. The method of moments first employed simply as a device for curve fitting, but in the end to have far-reaching consequences for the development of general statistical theory.

2. The system of skew frequency curves, as a technique for mathematically describing natural phenomena that individually vary.

3. The development of the theory of correlation and its application to the problems of heredity and evolution.

4. The χ^2 test for goodness of fit of theory to observations, coupled with the mathematical, logical, and statistical consequences and applications that grew out of it.

His most important *practical contributions* to the progress of statistical sciences were:

1. Teaching a long succession of students from many lands, who preached "the gospel to the whole creation," and included in their number such major figures as Yule and Greenwood.

2. The founding of *Biometrika* in 1900 and its editing for 36 years.

Others have been associated—Galton and Weldon as co-founders and various others as assisting editors—but the real genius of the enterprise has always been Pearson.

3. The *Tables for Biometricians and Statisticians*, and the *Tracts for Computers*, and other mathematical tables that cannot be listed for want of space.

The major contributions to *biology and eugenics* were:

1. The long series of memoirs on variation, heredity, and fertility that may perhaps justly be said to have culminated in the logically and mathematically rounded completion of Galton's Theory of Ancestral Inheritance.

2. The *Treasury of Human Inheritance.*

3. The founding and editing until retirement from the Galton professorship of *The Annals of Eugenics.*

These ten items of major achievement constitute a remarkable record even for a long life. Even so the list omits a host of interesting and significant by-products and digressions.

Leaving details and mere trivialities out of account the principal respects in which Pearson's work has led to controversy are two; one basically logico-mathematical, the other biological. The attempt will be made to show, necessarily briefly, that both really grounded themselves upon the same philosophical issue, in respect of which it seems fair to say on the evidence that K. P.'s opponents seem never to have quite clearly grasped his position or appreciated its fundamental cogency; also, on the biological issue at least, it appears that from his side he never quite gave the devil his due.

The first of the two matters referred to concerns the significance and usefulness of the system of skew frequency curves, and, by derivation, of curve-fitting in general. This has not been so much a subject of overt public controversy as of a sort of "whispering campaign," particularly in this country and England, in some part based upon honest doubt and uncertainty, but in part upon a vicious intent to defame a great man. The second matter concerns the mutual relationships of the Galtonian and Mendelian outlooks on the problems of inheritance. Here the controversy was open and violent.

In both cases the issue was similar; it was the age-old battle between the realist and the sentimentalist, here arrayed between the man who holds that science can never do more than *describe* how events have occurred, and him who wishfully hopes that science may somehow *explain* events. To Pearson the equation of a curve that fitted a wide range of natural phenomena was a convenient and useful short-hand description of certain characteristics of those phenomena *et praeterea*

nihil. For a particular curve he might know a lot or a little as the case might be about the relations between the mathematical constants and the physical sequences relative to the phenomena, commonly generically called causation. In the one case the curve would be conveniently denominated rational, in the other empirical. But I think that K. P. was not greatly impressed by this verbal distinction, having the faith that with the passage of time and the fullness of investigation we should ultimately come to know a lot about many things of which we now know only a little. A few months before his death he said (*Nature*, 136, 297, 1935): "From my point of view the tests [of the P, χ^2 type] are used to ascertain whether a reasonable *graduation* curve has been achieved, not to assess whether one or another hypothesis is true or false. If we narrow ourselves down to asking whether a normal curve will reasonably *graduate* the material and find it does, are we to follow it up by asserting that either sample or parent-population follows a normal distribution? I should say: Certainly *not*. I have never found a normal curve fit anything if there are enough observations! The astronomical data provided to prove that errors of observation follow normal curves are pitiably scanty, and if proper tests are applied usually show that they do not! The fact is that all these descriptions by mathematical curves in no case represent 'natural laws.' They have nothing in this sense to do with 'hypothesis' or 'reverse of hypothesis.' They are merely *graduation curves*, mathematical constructs to describe more or less accurately what we have observed.

"The reader will ask: 'But if they do not represent laws of Nature, what is the value of graduation curves?' He might as well ask what is the value of scientific investigations! A good graduation curve—that is, one with an acceptable probability—is the only form of 'natural law,' which the scientific worker, be he astronomer, physicist or statistician, can construct. Nothing prevents its being replaced by a better graduation; and ever bettering graduation is the history of science.

"What is the use of good graduation curves? Ask the actuary! Such curves enable a mass of details to be summed up with reasonable probability in the knowledge of a few constants, and from these constants we obtain new knowledge of the properties of the mass. Take only the importance of a life table graduated by the Makeham-Gompertz curve and consider, what new knowledge flows from it. But after all, it is only a graduation curve and it is open to anyone to find a better one!"

The essence of the controversy over heredity was found in the same philosophical point. In Pearson's view the sound way to investigate heredity was to describe and measure the kind and degree of somatic

resemblances between individuals and their kin, without regard to any theory as to the biological or physical causation of such likenesses as might be found. He justly held that whenever any adequate biological theory of heredity appeared it could not contradict, but must in fact encompass within its range the biometric findings. Mendelian experimentation demonstrated a germinal mechanism lying behind the somatic expression of hereditary differences, and established the biological bases of genetic causation. Nothing in this could endanger or even disturb the soundness of Pearson's underlying philosophical position, but in the early heyday of Mendel's rediscovered work, K. P., doubtless influenced by Weldon, unwisely questioned the accuracy and validity of the experimental results that the Mendelian experimenters were getting, and of which he had a somewhat less than adequate first-hand knowledge. In consequence his influence with the biologists was for a time weakened. With similar lack of soberly poised judgment the Mendelists endeavoured to throw to the wolves the whole body of observed biometric facts about heredity. But as was bound to be the case all this was only a passing phase. Pearson came quickly to see the importance of Mendelian discoveries, and indeed himself made important contributions to Mendelian theory by showing mathematically that on simple and reasonable assumptions regarding the gene-soma nexus Mendel's laws led to the expectation in populations of precisely the results in ancestral inheritance that had been biometrically described. Like many another example of human frailty the whole episode was deplorable. It did not really advance science in the least. On the contrary it is probable that genetics would be in a more advanced and generally sounder position today than it is if Karl Pearson and the great Mendelian leaders of the time had been able to work cordially and sympathetically together.

IV

In conclusion, what of the man? That his was one of the greatest intellects of his times admits of no reasoned doubt. But intellectual power alone does not make a man. What he uses it for, and how he lives with so precious and noble an endowment are the questions that must at the end be appraised. In the final analysis I think that Karl Pearson was primarily a great teacher. The whole pattern of his life and living set that purpose and motive above everything else. This may seem a strange thing to say of a man who published in his life time a total bulk of first-rate original research only rarely equalled in the whole history of science. But let us examine the point. In relation to his own personal research he always though of biometric and sta-

tistical methods, I am sure, merely as means to an end—tools of a trade—that end being the discovery of new laws and principles, particularly in the biological fields of evolution and heredity. Furthermore, with a touch of that self-delusion from which even the great never seem altogether to escape, I am sure that he honestly believed that he was chiefly devoting his own life to making such applications. But actually, as the record plainly shows, and particularly the grand record left in the pages of *Biometrika*, it is evident that as the years went on a larger and larger portion of his energies went into the developing, broadening, and deepening of the mathematical theory and methodology of biometry and statistics, while more and more the applications to the solving of particular objective biological problems were left to his assistants and pupils.

But precisely this is *teaching*—teaching not merely the pupils in the classroom, but teaching "all creation" in the biblical phrase. In short it seems to me that K. P. was after all really more interested in showing mankind how to go about unearthing the secrets of Nature than he was in digging them out himself. Herein, I think, did he most widely differ from Darwin, Galton, and Pasteur, with whom he may justly be compared as to inherent intellectual powers. No one of them was the teacher in the sense of being primarily motivated to train men in the way to do things for their own advancement. Each, on the contrary, was primarily a discoverer, moved by a consuming curiosity to find out about natural phenomena without much regard for or interest in the methodology involved, for no other conscious reason than the satisfying of that curiosity.

As a teacher Pearson was superb. He had the rare gift of complete clarity, coupled with an understanding appreciation of what the pupil was going to find difficult, and a willingness to take the pains in advance to eviscerate the point completely by numerical example and in other ways, so that anyone could understand the lesson who was willing to do some hard thinking and was sufficiently equipped by education and talent to have any rights in the premises. He was not the textbook type of teacher. What he gave in the classroom was more often than not what he currently had under investigation or had just completed. Unfortunately for the rest of us he never wrote a textbook.

His retiring nature, devotion to his work, hatred of publicity, inability to suffer fools with more than extremely moderated gladness, and the caustic vigor of some of his writing combined to give K. P. the reputation among those who did not know him well of being a very austere and difficult sort of person. Actually among his friends, in the laboratory tea room, or at home in Hampstead, he could be a most

genial, kindly, considerate, and entertaining companion. And as is the normal way of life he mellowed as he aged. In purely scientific relations he was unquestionably somewhat difficult. At the core of his being he was an extreme individualist who could not possibly have worked effectively on a "committee"; for anything that touched science however remotely he had his own extraordinarily high standards; and finally his quasi religious zeal for science had in it an element of that sort of intolerance that is so characteristic of all religious behaviour—the sort that tends instantly and automatically to define the two sides of any question as "my side and the wrong one." All these things made discipleship difficult at times. But this does not quite tell the whole story, at least in my own personal experience, for whatever it may be worth. For while K. P. and I fell apart many years ago about some scientific matters, which never thereafter were discussed between us, our friendship grew ever closer and deeper as the years went on, and I am sure mutually so.

So the record stands. A great figure has passed, whose like we shall not see again. The loss to science of a brilliant pioneer is real even though inevitable; to his old students the loss of a friend and worshipped hero is irreparable. For them is left only the comfort inherent in the serene words of Propertius:

> At non ingenio quaesitum nomen ab aevo
> Excidet: ingenio stat sine morte decus.

STATISTICS ON COPPER IN THE UNITED STATES[1]

By Y. S. Leong
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In its report to the National Resources Board the Planning Committee for Mineral Policy recommended that consumption forecasts for the nonferrous metals be established "to serve as a guide for current production and for investment in plant facilities."[2] If forecasting is to be attempted, statistical data are indispensable, although it may be questioned whether forecasting for such industries as the nonferrous metals is feasible at all. Statistics are needed not only for forecasting but for measuring and interpreting the changes in the economic activity of these industries. In this paper it is our object to analyze the quality of the existing data on one of the nonferrous metals—copper—with the view of determining their reliability for forecasting copper consumption and in recording the economic changes of the copper industry; to suggest such improvements in the available data as are necessary and such additional compilations as are needed for these purposes.

PRODUCTION

The United States Bureau of Mines has been compiling for a long period of time annual figures for the mine, smelter and refinery production of copper in the United States from domestic ores. Its mine production statistics are available from 1906 to date, its smelter from 1845 to date, and its refinery from 1906 to date.[3] The mine and refinery figures for the entire period for which the data are available and the smelter figures at least from 1900 on represent practically complete coverage. The three sets of statistics are obtained by canvassing annually all producers engaged in each of the three production processes —mining, smelting, and refining—by means of schedules and through field representatives.

[1] This paper is a summary, with additions and modifications, of a confidential report prepared by Robert W. Burgess and Y. S. Leong for the Central Statistical Board. The author is indebted to Oscar E. Kiessling, Helene M. Myer and Francis J. McCarthy, Jr., of the Bureau of Mines, and Aryness Joy, of the Central Statistical Board, for assistance and suggestions.

[2] See "Report of the Planning Committee for Mineral Policy," *Report of the National Resources Board*, December 1934, pp. 398–99.

[3] Prior to 1924, these and other figures on copper attributed here to the Bureau of Mines were gathered by the United States Geological Survey, the predecessor of the Bureau of Mines, which has continued the compilations from 1924 to the present. For convenience, these statistics are designated here as those of the Bureau of Mines. Unless otherwise stated all figures compiled by the Bureau of Mines are published in the following sources: prior to 1932, *Mineral Resources of the United States;* 1932 to date, *Minerals Yearbook*, U. S. Bureau of Mines.

The figures for smelter and refinery production seem better adapted to serve as a basis for current analysis than those for mine production. In the first place, there would be a margin of error in mine reports due to the necessity of estimating the recoverable metal content of the ores, although accurate adjustments in recent years have been made possible by the long experience and careful treatment of the Bureau of Mines. In the second place, as there are fewer smelters and refineries than there are mines, it is easier to obtain complete figures currently as needed by canvassing a relatively small number of smelters and refineries. Finally, smelter production represents the copper closer to the consumer.

There is little to choose so far as accuracy is concerned between the figures for smelter production and those for refinery output. Some copper—the Lake Superior variety—is smelted and sold as Lake copper without subsequent refining and some copper is extracted from ores by leaching methods which render smelting unnecessary. The Bureau of Mines in compiling its smelter and refinery figures has adjusted both series for the copper derived from the two sources. Thus its smelter production figures include blister as well as furnace-refined Lake and leached copper, and its refinery output figures include electrolytic as well as furnace-refined Lake and leached copper.

There is a considerable lag in time between the mining and smelting and refining of the copper. Two or three months usually elapse between the mining of the ore and the refining of the copper. For statistical analysis, particularly for forecasting purposes, it would seem that refinery production figures are more useful for they, together with statistics for existing stocks, show precisely the amount of copper available for consumption in a given period of time.

The decennial Census of Mines and Quarries for 1929 collected figures for mine production of copper from practically all producers. As these data have not been published or tabulated, it is not possible to compare the compilations of the Bureau of Mines with the figures gathered by the Census.

Beginning in 1929, the biennial Census of Manufactures has been requesting smelters for figures on blister production and refineries for figures on primary and secondary refinery production of copper. These statistics have also not been published. Even were they available they would not be comparable with those of the Bureau of Mines. In compiling its smelter or blister production figures the Bureau of Mines endeavors to classify the output derived from domestic ores separately from that obtained from foreign ores. The Census schedule calls for blister copper without reference to source. The Bureau of Mines segre-

gates its primary refinery output figures into domestic and foreign, while the Census calls for primary refinery data regardless of source. Finally the Bureau of Mines adjusts its smelter and refinery production figures for furnace-refined Lake copper and copper produced directly through the leaching of ores. In the Census schedule no mention is made of the copper derived from these processes.

As the Census of Mines and Quarries and the Census of Manufactures have never tabulated the production data they gathered, nor have they made use of them in any way except for checking purposes, and as the figures for blister and refinery production do not conform to the fundamental classifications of the Bureau of Mines, it is suggested that the Bureau of the Census and the Bureau of Mines should cooperate to formulate a joint schedule which will incorporate all the information essential to the two agencies. Such a cooperative effort will eliminate much of the existing duplication.

Monthly figures for mine production are available from January 1921 to December 1931 and for smelter production from January 1923 to December 1931. These series were compiled by the American Bureau of Metal Statistics which discontinued their reporting at the end of 1931.[4] Comparison of the annual totals of the monthly figures for mine production compiled by the American Bureau with the annual figures for mine production of the Bureau of Mines indicates that the two series are closely similar. The annual totals of the monthly figures for blister production of the American Bureau are, however, consistently higher than the annual figures for smelter production of the Bureau of Mines. The higher figures of the American Bureau are explained by the fact that they include some foreign and secondary copper. Taking into consideration the fact that they had to be reported currently, the figures for mine and smelter production of the American Bureau may be said to be sufficiently close to the truth to serve the purpose of current market analysis. It is regrettable that their reporting was terminated.

Since June 1933 the Copper Institute, the statistical subsidiary of the former Code Authority for the Copper Industry, has been compiling monthly figures for mine or smelter production of copper derived from domestic and duty-free ores,[5] and from secondary materials. These figures include the estimated recoverable copper contents of concentrates, blister and Lake copper produced, and are segregated

[4] These and other monthly series compiled by the American Bureau of Metal Statistics were reported regularly through mimeographed releases issued monthly. These statistics were also published in the *Survey of Current Business*, U. S. Bureau of Foreign and Domestic Commerce.

[5] Some 6,000 tons of duty-free copper are imported from Cuba each year.

into three series: primary copper produced by members of the Industry, primary custom production and secondary custom production. The series for primary copper produced by members of the Industry represents mainly mine production data. This, together with that for primary custom production, covers the mine output of practically the entire Copper Industry.

It is regrettable that the Copper Institute has not made public these figures nor any of its other valuable statistics,[6] which we shall have occasion to discuss later. Its compilations are intended for the confidential use of the members of the Industry. Recently, however, some of its figures on production, consumption and stocks have appeared regularly in trade journals,[7] apparently without the official sanction of the Institute. There is, of course, no assurance that their publication would continue indefinitely—would not cease, for instance, in the event that the statistical position of the Industry should be less favorable than it is now. The Institute cannot be too strongly urged to make its figures available to the public at all times, at least to make them available unconditionally for the use of such a government agency as the Bureau of Mines. If it should withhold from the public those monthly statistics which are needed for current analysis, it is suggested that the Bureau of Mines as an impartial agency undertake to compile them.

For statistical analysis, it is desirable to have a comparable and continuous monthly series going as far back as possible. The Institute's figures for mine or smelter production date back only to June 1933. For many years prior to June 1933, the Institute had been compiling monthly data on mine or smelter production. These figures have not been published and it is not known to what extent they differ from those compiled since the middle of 1933. It should be possible, however, on the basis of these earlier data and the annual figures of the Bureau of Mines to splice the Institute's present figures on the American Bureau's mine production series which, it will be recalled, began in January 1921 and discontinued in December 1931. Thus we shall have a continuous monthly series dating at least as far back as the beginning of 1921.

The Institute has also estimated the amount of refined copper[8] pro-

[6] The Copper Institute issues confidential, monthly mimeographed releases to the members of the Copper Industry, showing monthly figures of production, stocks, consumption, sales, and unfilled sales in the United States and also in the world and giving a list of the reporting companies.

[7] These figures are published regularly, usually soon after the 15th of the following month, in the *American Metal Market*, the *Wall Street Journal*, and other periodicals.

[8] In this connection it should be mentioned that a monthly series, dating back to January 1919, is available for refinery production of copper in North and South America. The figures from 1919 to 1923 were compiled by the Copper Export Association and since then by the American Bureau of Metal Statistics. Prior to December 1931, the American Bureau reported its data monthly but since then it

duced monthly by adding the change in producers' stocks to domestic invoicings and exports of domestic and duty-free copper. The figures so derived include some secondary copper, that is, copper produced from scrap by refineries engaged principally in the production of primary copper. The Institute should be able to compile a more accurate monthly series for refinery production by canvassing the refineries directly. Inasmuch as the number of refineries is relatively small, the canvassing should not be difficult. In compiling the refinery data, it is suggested that primary and secondary production be classified separately and primary output be segregated into that which is produced from domestic ores and that which is derived from foreign sources.

Any analysis of the activity in the Copper Industry would be incomplete without taking into consideration the output of secondary copper, that is, copper derived from new and old copper and brass scrap. The production of secondary copper has become more and more an important factor in the copper market and will become an even more significant factor in the future. In recent years it exceeded primary output by as much as a third. Moreover, its importance as a market factor is augmented by the fact that it is more elastic than primary output, that is, an increase in price is likely to call forth a greater volume of secondary than of primary production. The only available statistics representing practically complete coverage of the secondary output are those compiled once a year since 1906 by the Bureau of Mines. If current statistical investigations, such as forecasting, are to be made, figures for secondary copper production at quarterly, if not monthly, intervals should be compiled and published regularly.

EMPLOYMENT AND PAYROLLS

Two related types of data should perhaps be mentioned in connection with the production figures: employment and payrolls. While statistics on employment and payrolls are not pertinent to the problem of forecasting the consumption of copper, they are, nevertheless, valuable for the purpose of studying the economic behavior of the Copper Industry.

The Bureau of Mines in making its annual surveys of mine accidents has, since 1911, been compiling annual figures showing the average number of persons employed in copper mining during that period of

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has been publishing its monthly figures only once a year in the *Year Book of the American Bureau of Metal Statistics*. For analyses of domestic market trends this series, because of its inclusion of copper produced in foreign countries, is of little value.

each year in which the mines are in operation.[9] It has never gathered, however, any data on payrolls. Figures on a quinquennial basis for the number of wage earners reported as employed in the mining of copper on the 15th day of each month and the total payments to workers in copper mining during the year have been assembled by the Census of Mines and Quarries.[10] The Census of Manufactures has been compiling biennial figures showing the number of wage earners on the payrolls of establishments engaged in the smelting and refining of copper for the week which included the 15th day of each month and the total amount of wages paid to the workers in these establishments during the year.[11]

Monthly statistics for the number of wage earners engaged in the mining, smelting or refining of copper and for the amount of wages paid to these workers are not separately available. The Bureau of Labor Statistics, however, has, since January 1931, been gathering monthly figures for the number of wage earners and the amount of wages paid to these workers in the week ending nearest the 15th of the month in the metal-mining industries, which are published under the caption "metalliferous mining," and which include the copper mining industry. But the figures for the copper mining industry alone have never been published. Similarly the monthly figures compiled by the Bureau for employment and payrolls in the smelting and refining divisions of the Copper Industry are not separately shown but classified under "smelting and refining—copper, lead and zinc."[12]

As complementary measures of productive activity employment and payroll data for the metal industries are sufficiently important to merit a more refined classification than that which is adopted by the Bureau of Labor Statistics. It is hoped that the Bureau will soon have monthly figures showing employment and payrolls for each of the three production divisions of the Copper Industry—mining, smelting, and refining.

STOCKS

Since 1906 the Bureau of Mines has been compiling once a year two series, one showing the stocks of "blister and materials in process of refining" and the other, the stocks of "refined copper" located in smelters and refineries in the United States, as of the first of each year.

[9] Employment data gathered by the Bureau of Mines are published in *Metal-Mine Accidents in the United States.*

[10] *Mines and Quarries—1929*, 15th Census of the United States, U. S. Bureau of the Census.

[11] For figures on employment and wages, 1899–1929, see *Manufacturing—1929*, 15th Census of the United States; for those subsequent to 1929 see *Biennial Census of Manufacturers*, U. S. Bureau of the Census.

[12] See *Employment and Payrolls*, a monthly publication of the U. S. Bureau of Labor Statistics.

Practically every smelter and refinery has been covered in the canvass. These figures are defective in that they fail to show the large stocks of copper held by the fabricators of copper products and the consumers of copper. In recent years these consumers and manufacturers have been holding a considerable amount of copper.

Since June 1933 the Copper Institute has been compiling monthly figures showing the stocks of copper held in the Industry and outside of the Industry at the end of each month.[13] Industry or producers' stocks are classified into those held at refineries and those on consignments. The Institute also estimates the surplus stocks of copper controlled by the copper producers by deducting from the total producers' stocks the amount of copper sold but not delivered, and the estimated normal stocks necessary for the producers to carry. The coverage of the producers' stock figures is practically complete. Non-industry stocks are segregated into those held by consumers, by non-consumers and at the New York Commodity Exchange. Consumers' stocks are subdivided into "consumers' stocks at refineries," "refinery shapes at consumers' plants," and "copper in process of fabrication and in fabricated forms at consumers' plants and warehouses." By adding the "unfilled purchases of refined copper under contracts" to, and deducting the "unfilled sales of copper products under contracts" and the estimated "normal stocks required for half a month's consumption" from the total consumers' stocks, the Institute arrives at an estimate of the surplus stocks controlled by the copper consumers. Consumers' stocks data cover the copper carried by the important copper users, who hold practically all the available refined stocks except those in the hands of the producers and speculators. Non-consumers' or speculators' stock figures indicate the copper held by purchasers other than those having fabricating plants or having fabrication done for them on toll. The stocks held by speculators comprise but a small fraction of the total stocks. Probably most of the small amount of copper stocks at the New York Commodity Exchange is to be attributed to the speculators.

The Copper Industry has in recent years been cursed with excessive stocks carried by producers and consumers. The stock data should

[13] Monthly figures for refined copper stocks located in refineries in North and South America at the end of each month are available from January 1919 to date. From 1919 to 1923 they were compiled by the Copper Export Association and from 1923 to the present by the American Bureau of Metal Statistics. Prior to December 1931, the American Bureau reported these data monthly but since then it has been publishing them only once a year in the *Year Book of the American Bureau of Metal Statistics*. These statistics represent largely producers' stocks. Comparison of the annual totals of the monthly figures for refined stocks in North and South America with the annual figures for refined stocks in the United States, as compiled by the Bureau of Mines, indicates that there is on the whole a close agreement between the two series. A convenient source of these data is the *Survey of Current Business*. (See 1932 Annual Supplement and 1936 Supplement.)

continue to aid the copper producers in their efforts to stabilize their output and both the producers and users of the metal in their efforts to reduce their stocks or to prevent unduly large accumulation of their stocks. The stock figures of the Institute should be exceedingly helpful to those analyzing the supply and demand situation in copper and to business men who have to decide policies in this field of industrial activity. In recent months two of the Institute's stock series have been published in trade journals, one for refined stocks held by producers and the other for total refined stocks.

SALES AND SHIPMENTS

Since June 1933 the Copper Institute has been estimating monthly sales of copper in tons, made domestically by members of the Copper Industry.[14] These figures are arrived at by adding the domestic invoicings to the change in the total unfilled sales contracts of the copper producers. The Institute has also been computing monthly figures showing consumers' physical volume sales of products fabricated from copper originating in the Copper Industry. These sales data, like the other figures which the Institute compiles, are kept confidential.

If reliable data on production and stocks are available, the gathering of statistics on sales or shipments is not indispensable, for it is possible on the basis of the information on production and stocks to derive figures on sales and shipments.

EXPORTS AND IMPORTS

Monthly figures of the exports and imports of copper in quantity and value are available from 1866 to the present.[15] The number of classifications in the earlier years was comparatively small. The figures were regrouped from time to time, with some of the old classifications discarded and new ones added. At the present time figures for copper exports as compiled by the Bureau of Foreign and Domestic Commerce are grouped into nine major classes: (1) ores, concentrates, matte, blister, etc.; (2) refined copper in ingots, bars, etc.; (3) old and scrap; (4) pipes and tubes; (5) plates and sheets; (6) rods; (7) wires; (8) insulated copper wire and cable; (9) other copper manufactures. Copper imports which are designated as "imports for consumption" are classi-

[14] Monthly figures showing the shipments of refined copper to the United States from refineries located in North and South America are available from January 1919 to date. The figures prior to January 1924 were gathered by the Copper Export Association; those from January 1924 to the present have been compiled by the American Bureau of Metal Statistics. Until December 1931 the American Bureau reported these data monthly; since then, it has been publishing them only once a year in the *Year Book of the American Bureau of Metal Statistics*.

[15] Monthly figures for exports and imports are published in *Monthly Summary of Foreign Commerce of the United States*, U. S. Bureau of Foreign and Domestic Commerce.

fied in to eight groups: (1) bonded for smelting, refining and export; (2) Cuban concentrates; (3) regulus, coarse metal, etc.; (4) unrefined, black, blister, etc.; (5) refined; (6) scrap; (7) composition metal; (8) copper manufactures not otherwise specified.

Except for the small amount which is withdrawn for domestic consumption, the copper imported in bond will eventually be exported. It should be pointed out, however, that the figures for copper imports "bonded for smelting, refining and export" as reported by the Bureau of Foreign and Domestic Commerce do not represent the copper actually imported during any given month but that exported during the month.[16] In other words, copper imports in bond are not reported in the publication of the Bureau of Foreign and Domestic Commerce until the month in which they are exported. This being true, it follows that the difference between its exports of a given month and the "imports for consumption" of that same month will approximate closely the net exports (or the net imports, as the case may be) of that month.

PRICES

The Bureau of Mines has been compiling an annual price series showing the weighted prices of copper in the United States from 1850 to the present. These figures represent prices obtained by copper-selling agencies in the United States weighted by the quantities sold.

The *Engineering and Mining Journal* and the *American Metal Market*, among others, have been compiling average monthly prices for electrolytic copper in New York. Both sources are widely used. Because of a difference in the basis used the quotations of the *Engineering and Mining Journal* are invariably lower than the *American Metal Market* prices at New York.[17] The *American Metal Market* quotations at New York, in turn, are 0.125 of a cent per pound lower than prices delivered at Connecticut points. The copper prices used by the United States Bureau of Labor Statistics in its Index of Wholesale Prices are identical with the *American Metal Market* quotations at New York.

Attention should perhaps be called to another price quotation—the price for electrolytic copper delivered free alongside ship (F.A.S.) for export, which is quoted by the *American Metal Market* and other

[16] The copper imported for smelting, refining, and export is designated as "entries for warehouse" upon its entrance into the United States. "Entries for warehouse" for any given month, therefore, represent the copper actually imported during that month. When the copper is finally exported, it is shown in the publications of the Bureau of Foreign and Domestic Commerce as "copper imports bonded for smelting, refining and export" for the month in which the metal is exported. Since January 1934, however, figures showing "entries for warehouse" have not been published.

[17] The *Engineering and Mining Journal* series is based on sales for both prompt and future deliveries and, therefore, represent average of weighted prices for the month. The *American Metal Market* series, on the other hand, represent the average of unweighted daily prices for the month.

journals. When the domestic price of copper is fixed by agreement among producers, as for instance when the Code of Fair Competition for the Copper Industry was in effect, this quotation reflects the influence of supply and demand factors and represents the best domestic version of the world price of copper.

CONSUMPTION

Actual statistics of the amount of copper consumed in the United States are not available. The Bureau of Mines has estimated the amount of new copper withdrawn annually from available supply on domestic account by adding its stocks at the beginning of the year to, and deducting the copper exported during the year and the stocks at the end of the year from, the total supply of new copper of the given year. The new copper withdrawn in any given year, however, does not show the actual consumption of the year, for in the first place, the consumers' stocks are not taken into account, in the second place, some of the copper withdrawn may later be exported in the form of fabricated products, and finally, there is a considerable amount of secondary copper consumed which is not included in the figures of new copper withdrawals.

Since June 1933 the Copper Institute has been estimating the monthly consumption of domestic and duty-free copper in the United States. These estimates are made on the basis of domestic invoicings by the copper industry and changes in the stocks of consumers and speculators, with some allowance for domestic and duty-free copper exported in unfabricated forms. They are an improvement over those of the Bureau of Mines, for they take into account the changes in the stocks of consumers and speculators and include that part of the output of secondary which is produced in the plants of the Copper Industry. They are defective, nevertheless, in at least two respects: in the first place, some of the copper which is in the process of fabrication at the date of one monthly report may later be exported in manufactured form, and in the second place, no account is taken of the consumption of that large part of the secondary output which is produced by secondary producers who are outside of the copper industry.

Even if the consumption estimates of the Bureau of Mines and the Copper Institute were free from defects, their use for forecasting purposes would nevertheless be limited. For short-time forecasting, or for any current economic analysis these over-all figures would not reveal the differences in the changes of the business activities of the various copper-consuming industries during the various phases of the business cycle. The automobile industry, for instance, has during the recent

recovery phase increased its business activities considerably more than some of the other copper-consuming industries, such as the electrical and building industries. In any over-all figures, however, this rise in the use of copper in one industry may be obscured by a decline in other industries. Even for the study of long-time trend, these estimates of consumption tend to obfuscate the differences in the rates of growth of some industries and the dissimilarities in the rates of decline in others. Some of the copper-consuming industries may, or will soon, have attained their maximum growth, and their trends are likely to flatten out, if not to decline, in the near future. Others may continue to grow for some years to come. If reliable forecasts of copper consumption are to be undertaken currently, statistics on copper consumption by industries, compiled regularly at quarterly or monthly intervals, are absolutely essential.

The only available figures showing the amount of copper consumed by copper-using industries are those of the American Bureau of Metal Statistics.[18] These are estimated figures, representing the quantity of copper used annually by the following industries or groups of industries: electrical manufacture, telephone and telegraph, light and power, wire cloth, other rod and wire, ammunition, automobile, building, casting, clock and watch, coinage, copper-bearing steel, fire-fighting apparatus, radiator and heating, radio, railway equipment, refrigerator, shipbuilding, washing machine, water heater, air conditioning, manufactures for export, and others. The American Bureau has not made public the methods by which each of its series was estimated.[19] In the absence of information as to how these figures were actually obtained, there is, of course, no satisfactory way of testing their accuracy.

Some idea of the reliability of these estimates may be obtained by comparing them to some series which reflect the productive or business activities of the corresponding copper-using industries. It should be pointed out, however, that perfect correlation between the estimated series representing copper consumption and the series indicative of business changes in that copper-consuming industry does not neces-

[18] See *Year Books of the American Bureau of Metal Statistics.*

[19] Upon inquiry, the American Bureau disclosed that in general its methods are "adapted to what is industrially practicable." In some cases, a complete or practically complete canvass of all manufactures is made. In others, where the reports are incomplete but where they are "representative of so large a proportion (commonly upward of 50 per cent)," the estimates are made on the assumption that the total use of copper in the copper-using industry is in the same ratio as the sample. In still others the estimates are arrived at by applying the average amount of copper consumed per unit of production to the total number of articles reported to have been manufactured by the copper-using industry. Efforts made to obtain more specific information from the American Bureau than that which is outlined above have not been successful.

sarily mean that the estimated figures are reliable. It may well be that the very series which we use for comparison were actually employed by the American Bureau as a basis for its estimates.

Graphic comparisons of the more important of the estimated series with such data reflecting the business activities in the corresponding copper-using industries as are available shows that, on the whole, there is a general agreement between the changes in the amount of copper consumed in the several industries or industrial groups and the fluctuations in those series indicative of the business operations of the corresponding copper-consuming industries. Nevertheless, a definite conclusion cannot be drawn regarding the accuracy of the estimates unless the method by which they were arrived at is known. Only if it can be established that they were obtained by canvassing the users of copper and not on the basis of those series which reflect the business changes of the copper-consuming industries may the estimates be said to be fairly reliable.

CONCLUSION

Copper is an important national resource which is exhaustible and irreplaceable. It should be conserved by wise and efficient use. Complete quarterly or monthly statistics covering all factors of supply and demand—primary and secondary production, producers' and consumers' stocks, exports and imports, prices, and consumption by principal copper-using industries—should be compiled to aid in the development of a conservation program, if for no other purpose. Where such data are not available it is suggested that the Bureau of Mines, which has had long experience in gathering mineral statistics, undertake to fill in the gap. These compilations should be published promptly and regularly and should be presented in the form of totals so as not to reveal information concerning the individual companies.

THE PROBABILITY DISTRIBUTION OF PROTECTION TEST RESULTS

By Hugo Muench
The Rockefeller Foundation

The protection test is based on the ability of the serum of individuals who have recovered from certain infections to protect susceptible test animals from the results of inoculation with the infective agent. Preferably, the result is readable on the basis of the numbers of animals surviving and dying in a group used to test a given serum. High mortality in the group is taken to indicate lack of protective power in the serum. Conversely, low mortality is interpreted as meaning that the serum contains protective substances and hence was furnished by an individual who has most probably, in the past, recovered from an attack by the same infective agent. Animals used in such protection tests may therefore be divided into two hypothetical populations: the "protected" which have received positive serum and the "unprotected" receiving negative serum.

A group of n animals used to test a serum corresponds to an nth power binomial in that $(n+1)$ different results are possible. In order to establish criteria for the classification of sera into "positive" and "negative" categories, it is necessary to know something of the frequency distribution of these possible results in the case of either class. Once we know the relative frequency of occurrence of a given test result in either case, we can state with some certainty the probability that a serum giving this result is positive.

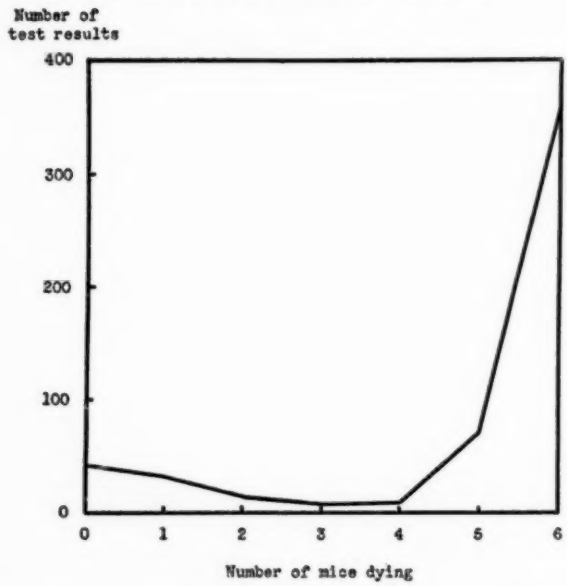
The analyses in this paper are based on the yellow fever protection test, for which a great amount of material is available. The technique of this test has been described [1, 2].[1] The infective agent is neurotropic yellow fever virus. Under the conditions of the test this is lethal to the animals used, which are white mice of a quite uniformly susceptible strain. Considerable protection against death is afforded the mice by sera of individuals who have recovered from yellow fever even many years previously. The results are read as a fraction (as 5/6) of which the denominator is the number of mice alive four days after inoculation, the numerator the number surviving six days later or ten days after inoculation. Groups of six mice are standard, though results can be read also on the basis of four or five. This study is confined to

[1] The numbers in brackets refer to the bibliography on p. 689.

the analysis of six-mouse results, and these results are expressed in this paper in terms of mice dying rather than those surviving, as we are concerned specifically with mortality rates.

When the results of a "run" of a considerable number of tests are plotted (Figure 1) it is generally found that the array is bimodal. One peak is at or near 0/6 deaths and the other at the other end of the range, or 6/6. This would indicate that the array of test results was a mixture of samples from two different populations, possibly corresponding to those "protected" and "unprotected" which have been postulated.

FIGURE 1
RESULTS OF TYPICAL "RUN" OF TESTS



The question now is: What are the characteristics of the two parent populations? The essential difference between the two would naturally lie in the lowering of the mortality rate resulting from the injection of immune serum into the mice. A protection test technique, employing fixed quantities of a stable virus, would be expected to show a relatively fixed mortality rate in a uniform mouse population receiving serum with no protective power. Those mice receiving a protective serum should show a mortality rate below the first to an extent depending on the degree of protective power of the serum. As a matter of fact, a practical problem in the development of any protection test is the gauging of virus and serum dosages so that there shall be the widest possible difference between the two mortality rates.

The question then becomes: What is the value, or the distribution, of the mortality rate for each of the parent populations? If the rate is expressible in a single value, as p, then each population is represented in the array of test results by a simple binomial of the form $[p+(1-p)]^n$, where n is the number of mice used in each test group. If the rate is not a single value but rather a distribution, then the result will be of a more complex binomial type. To begin with, we may assume that single values can express both "protected" and "unprotected" mortalities, respectively; the solution then is the separation of the simple binomials of which the array of test results is assumed to be composed. There are several ways to go about this:

Suppose we assume that "protected" mortality is so low that it will scarcely affect the number of results with five and six deaths. Then we can find a value for the "unprotected" mortality rate from these two points by

$$p = ny_n/(ny_n + y_{n-1}) . \tag{1a}$$

Conversely, assuming that "unprotected" mortality is so high that the number of tests showing one or no deaths will not be seriously affected, we can determine a value for "protected" mortality by

$$\pi = y_1/(ny_0 + y_1) \tag{1b}$$

where p = mortality rate in "unprotected" mice
π = that among "protected" mice
n = the power of the binomial (in this case 6)
y_i = the number of tests showing i deaths.

From each of these two values, the remainder of the hypothetical distribution of the corresponding fraction is calculated by simply extending the binomial through the remaining terms.

This method, which we may call the "endpoint fit," is illustrated by an example (Table I) employing the data plotted in Figure 1. This was an actual run of 528 sera from Brazil and Venezuela. The mortality rates were obtained by equations (1) as follows:

$$p = (355\times6)/(355\times6+71) = 0.9677$$
$$\pi = 31/(42\times6+31) = 0.1095$$

Evidently the sum of the two binomials does not account for the frequencies in the intermediate terms of the array. The discrepancy is serious, as "P" (by chi-square) is only 0.00095. A similar discrepancy appears regularly whenever positive sera are included in a run; it is never in the opposite direction. When a run consisted of negative sera only, the "endpoint" fit has always been good.

By the "endpoint" method, each derived mortality rate depends on only two frequencies. It must therefore suffer considerably from sampling fluctuations. To overcome this difficulty, it is possible to derive values for both rates simultaneously, from all elements of the array, by a method of moments.[2] In a "double binomial," such as is assumed here, three unknowns must be found:

P = "unprotected" mortality
π = "protected" mortality
U = proportion of all tests "unprotective" (i.e., negative)

Further, we shall use

x = result in number of deaths per mouse group
y_x = number of tests giving such result
n = power of binomial (number of mice per group) and
ν_α = the αth moment of the array $(= \Sigma x^\alpha y / \Sigma y)$

The moments of the double binomial are

$$\begin{aligned}
\nu_1 &= n[Up + (1-U)\pi] \\
\nu_2 &= n[Up + (1-U)\pi] + n(n-1)[Up^2 + (1-U)\pi^2] \\
\nu_3 &= n[Up + (1-U)\pi] + 3n(n-1)[Up^2 + (1-U)\pi^2] \\
&\quad + n(n-1)(n-2)[Up^3 + (1-U)\pi^3]
\end{aligned} \tag{2}$$

and from them the following functions are derived:

$$\begin{aligned}
\phi_1 &= \nu_1/n = U(p-\pi) + \pi \\
\phi_2 &= (\nu_2 - \nu_1)/(n(n-1)) = U(p^2 - \pi^2) + \pi^2 \\
\phi_3 &= (\nu_3 - 3\nu_2 + 2\nu_1)/(n(n-1)(n-2)) = U(p^3 - \pi^3) + \pi^3.
\end{aligned} \tag{3}$$

On solving, it is found that π is one root of the equation

$$\pi^2(\phi_1^2 - \phi_2) + \pi(\phi_3 - \phi_1\phi_2) + (\phi_2^2 - \phi_1\phi_3) = 0 \tag{4}$$

while p is the other root. p is given also by

$$p = (\phi_2 - \phi_1\pi)/(\phi_1 - \pi) \tag{5}$$

and U by

$$U = (\phi_1 - \pi)/(p - \pi)\,. \tag{6}$$

Using this method on the data of Table I, the results are:

Σxy	2,599	ν_1	4.92235	ϕ_1	0.82039
Σx^2y	14,845	ν_2	28.11552	ϕ_2	0.77311
Σx^3y	86,455	ν_3	163.74050	ϕ_3	0.74366

$$-0.10007\pi^2 + 0.10941\pi - 0.01239 = 0$$

[2] Pearson [3] published a solution for the "double binomial" when the power of the binomial was unknown. When it is fixed, the solution is greatly simplified.

$\pi = 0.5467 - 0.4184 = 0.1283$
$p = 0.5467 + 0.4184 = 0.9651$
$U = 0.6921/0.8368 = 0.8271$

TABLE I
"ENDPOINT" FIT

Test Results	Number of Mice Dying							Total
	0	1	2	3	4	5	6	
Observed frequencies	42	31	13	7	9	71	355	528
Hypothetical frequencies for $p = 0.9677$	—	—	—	0.3	6.0	71.0	355.0	432.3
Hypothetical frequencies for $\pi = 0.1095$	42.0	31.0	9.5	1.6	0.1	—	—	84.2
Hypothetical totals	42.0	31.0	9.5	1.9	6.1	71.0	355.0	516.5

The fitted frequencies for these mortalities are shown in Table II. The fit is now much better ($P = 0.06$) and it is evident that the deviations of hypothetical frequencies from observed are more evenly distributed. But there is still a tendency to "undershooting" in the mid-zone, balanced by compensating deviations at the ends, and this again is the picture whenever we fit runs of tests containing a number of positive sera.

TABLE II
"DOUBLE BINOMIAL" FIT

Test Results	Number of Mice Dying							Total
	0	1	2	3	4	5	6	
Observed frequencies	42	31	13	7	9	71	355	528
Hypothetical frequencies for $p = 0.9651$	—	—	—	0.3	6.9	76.6	352.9	436.7
Hypothetical frequencies for $\pi = 0.1283$	40.0	35.4	13.0	2.6	0.3	—	—	91.3
Hypothetical totals	40.0	35.4	13.0	2.9	7.2	76.6	352.9	528.0

The assumption of single mortality values clearly does not hold. The difficulty is probably with positive or "protective" sera, for the following reasons:[3]

(a) Runs including negatives only are well fitted by simple binominals.

(b) The values of "p" derived from endpoint fits are usually close to those given by the double binomial method. "π" is generally higher by the latter method.

[3] See also reference [4].

(c) Successive runs from the same laboratory give values for "p" differing very little and lying on a trend that rises slightly with time. Successive values of "π" vary widely, indicating sampling from a broader universe.

If the mortalities are not single values, they must occupy a band within which they are distributed in some fashion. The limits of this band must be between 0 and 1; further than this we cannot specify. The nature of the distribution within the band may be highly arbitrary, since it depends on the particular group of sera being tested. For example, a run which happened to include a large number of sera of high protective value would have a distribution of "protected" mortalities different from that of a run in which most of the positive sera were weakly protective. We cannot therefore rationalize the choice of any particular function to describe the distribution of mortalities on theoretical grounds and so shall confine ourselves to the following assumptions:

(a) Mortality values may fall anywhere between 0 and 1, and may therefore be expressed by some continuous function with these limits.
(b) In large arrays of tests, inequalities between different groups of sera will disappear sufficiently to allow the mortality distributions of the totals to approach a regular form.
(c) These distributions may be described with sufficient accuracy by some simple form of probability curve that the constants of the curve (such as mean and standard deviation) will have a real meaning. We may call this the "curve of origin."

The curve of origin will give rise to a complex or "chain" binomial whose form is determined by the shape of the curve. Then, if we are able to fit such a chain binomial to an actual series of test results, we may conclude that its curve of origin does present something very much like a picture of the variations of the underlying mortality rate. Since the choice of a function for the curve must be largely empirical, we may select one which is reasonably flexible in its possible shapes and which may readily be integrated with the binomial.

Greenwood and Yule [5] studied "chain Poisson" series arising from curves of the type

$$y = kx^n e^{-ax}$$

This distribution is not appropriate here, since both the series and the curve of origin extend to infinity while we are limited to a binomial and to mortalities ranging from 0 to 1. Nevertheless, reasonably good

approximations to our data can be obtained by this method since in this case the "tails" are so small that they are relatively unimportant.

For our purposes, as curve of origin, it is better to try the function

$$y = kp^s (1-p)^t \tag{7}$$

where[4] $k=(s+t+1)!/(s!t!)$ when the area under the curve is put equal to 1. The curve may take almost any simple shape between the limits of 0 and 1, which are those of the possible mortality range.

The development of the chain binomial arising from this curve can be handled by methods analogous to those used by Greenwood and Yule (*loc. cit.*) for the chain Poisson. The notation is simple:

p (or π) = mortality rate
n = power of binomial (number of mice in group)
s and t = parameters of the curve of origin (equation [7])

Then for the relative frequency of results with no deaths, we have

$$\begin{aligned} f_0 &= \frac{(s+t+1)!}{s!t!}\int_0^1 p^s(1-p)^t(1-p)^n dp \\ &= \frac{(s+t+1)!}{s!t!}\,\frac{s!(t+n)!}{(s+t+n+1)!} \end{aligned} \tag{8}$$

and for the frequency of results with one death

$$\begin{aligned} f_1 &= \frac{(s+t+1)!}{s!t!}\int_0^1 p^s(1-p)^t np(1-p)^{n-1}dp \\ &= n\,\frac{(s+t+1)!}{s!t!}\,\frac{(s+1)!(t+n-1)!}{(s+t+n+1)!} \end{aligned} \tag{9}$$

and so to the frequency at n deaths, which is

$$\begin{aligned} f_n &= \frac{(s+t+1)!}{s!t!}\int_0^1 p^s(1-p)^t p^n dp \\ &= \frac{(s+t+1)!}{s!t!}\,\frac{(s+n)!t!}{(s+t+n+1)!}. \end{aligned} \tag{10}$$

Summing, we have for the entire array

$$\Sigma y = \frac{(s+t+1)!}{s!t!}\,\frac{s!t!}{(s+t+n+1)!}\Big[(t+1)(t+2)\cdots(t+n)$$

[4] Pi-functions or generalised factorials (written "$n!$") are here used in place of the more usual Gamma-functions, in order to simplify subsequent procedures.

$$
\begin{aligned}
&+\frac{n}{1!}(s+1)(t+1)\cdots(t+n-1)\\
&+\frac{n(n-1)}{2!}(s+1)(s+2)(t+1)\cdots(t+n-2)+\cdots\\
&+\frac{n!}{n!}(s+1)\cdots(s+n)\Big]\\
&=\frac{(s+t+2)\cdots(s+t+n+1)}{(s+t+2)\cdots(s+t+n+1)}=1\,.
\end{aligned}
\tag{11}
$$

The elements of the first equation of (11) give the relative frequencies of the elements of an nth-power chain binomial array arising from a frequency curve of the type of equation (7) and with parameters of s, t. These parameters may be obtained from the first and second moments of the actual array, since (when $\Sigma y=1$)

$$
\begin{aligned}
\Sigma xy=\nu_1&=\frac{1}{(s+t+2)\cdots(s+t+n+1)}\\
&\quad[0+n(s+1)(t+1)\cdots(t+n-1)\\
&\quad+n(n-1)(s+1)(s+2)(t+1)\cdots(t+n-2)+\cdots\\
&\quad+n(s+1)\cdots(s+n)]\\
&=\frac{n(s+1)}{(s+t+2)\cdots(s+t+n+1)}\\
&\quad[(s+t+3)\cdots(s+t+n+1)]=\frac{n(s+1)}{s+t+2}
\end{aligned}
\tag{12}
$$

$$
\begin{aligned}
\Sigma x^2y=\nu_2&=\frac{1}{(s+t+2)\cdots(s+t+n+1)}\\
&\quad[0+n(s+1)(t+1)\cdots(t+n-1)\\
&\quad+2n(n-1)(s+1)(s+2)(t+1)\cdots(t+n-2)\\
&\quad+\frac{3n(n-1)(n-2)}{2!}(s+1)\cdots(s+3)(t+1)\\
&\quad\cdots(t+n-3)+\cdots+n^2(s+1)\cdots(s+n)]\\
&=\frac{n(s+1)}{(s+t+2)\cdots(s+t+n+1)}\\
&\quad[(s+t+4)\cdots(s+t+n+1)(ns+t+2n+1)]\\
&=\frac{n(s+1)(ns+t+2n+1)}{(s+t+2)(s+t+3)}
\end{aligned}
\tag{13}
$$

where x is the number of mice dying per group.

ϕ functions are calculated as in equation (3). They are:

$$\phi_1 = \nu_1/n = (s+1)/(s+t+2)$$

$$\phi_2 = (\nu_2 - \nu_1)/(n(n-1)) \tag{14}$$

$$= [(s+1)(s+2)]/[(s+t+2)(s+t+3)]$$

and from them the parameters s, t are calculated by

$$s = (\phi_1(\phi_1 - \phi_2))/(\phi_2 - \phi_1^2) - 1 \tag{15}$$

$$t = (n+1)/\phi_1 - (n+2)\,. \tag{16}$$

The ϕ functions of the chain binomial are exactiy the same as the corresponding moments about zero (νs) of the curve of origin. The characteristics of this curve are:

$$\text{Mode} = s/(s+t) \qquad \text{Mean} = \nu_1 = (s+1)/(s+t+2)$$

$$\mu_2 = \sigma^2 = [(s+1)(t+1)]/[(s+t+2)^2(s+t+3)]\,.$$

Since there is no direct method for the separation of a mixture of two samples distributed on this basis, it is necessary to use a method of successive approximations. This requires a large number of test results. Therefore the tests of an entire year from one laboratory were included in one array. Tests covering two years (1933–4 and 1934–5) for each of two laboratories (New York and Bahia) furnished four arrays for comparison. Each contained some 1500 to 4500 results read on a six-mouse basis. As so long a span of time was included in each, it seemed better to assume that "unprotected" as well as "protected" mortality rates might take the form of frequency distributions. During one run "unprotected" mortality might have a single value; over the course of a year it would almost certainly vary due to changes in virus potency, differences in experimental conditions between runs and the like.

The first step was to make an approximation to the distribution of negative sera by fitting an "endpoint" binomial to the results with 6/6 and 5/6 deaths. The hypothetical frequencies so computed were subtracted from the entire array, leaving a residue which formed the basis for the first approximation to the positive distribution. This residue was fitted with a chain binomial, and the resulting hypothetical distribution was subtracted from the entire array of tests, leaving a residue on which to base the second approximation to the negative distribution by means of a chain binomial. The process was repeated, if necessary, to obtain a reasonable fit.

The results for only one array are shown in detail (Table III)—that of New York laboratory results from May, 1933, through April, 1934. The results of fitting the other arrays of tests were about equally close. Table III shows, for comparison, the results of fitting the same data with a double binomial and a chain Poisson. The chain Poisson,

TABLE III

OBSERVED AND HYPOTHETICAL MOUSE TEST RESULTS, NEW YORK LABORATORY, MAY 1933–APRIL 1934

	Number of Mice Dying							Total	Goodness of Fit (P)
	0	1	2	3	4	5	6		
Observed frequencies	345	135	64	53	111	496	1857	3061	
Hypothetical: "Double Binomial"	317	199	52	13	77	578	1825	3061	0.000000
"Chain Poisson"	331	159	67	44	112	505	1852	3070	0.01
"Chain Binomial"	339	143	71	56	104	500	1854	3067	0.2
Hypothetical distribution of 1000 sera: Negative	—	—	1	6	44	220	730	1000	
Hypothetical distribution of 1000 sera: Positive	585	219	108	53	24	9	2	1000	

like the chain binomial, uses three constants for fitting each of the two populations. The degrees of freedom are so reduced to 1, and the values of "P" are low in view of the apparent closeness of fit. The equations of the two curves of origin for the chain binomials are:

Positive sera: $y = 1.9442\pi^{-0.3345}(1-\pi)^{3.4505}$

Negative sera $y = 420.09p^{32.0547}(1-p)^{0.6940}$.

The last two lines of Table III show the relative expected frequencies of results for positive and negative sera on the basis of the above curves. These values are obtained directly from equation (11) and provide estimates of the probability of a given result being positive. It is evident that a negative serum will almost never show less than 3/6 deaths, while a positive rarely shows more than 4/6. In the intermediate zone, the probability would depend on the total number of positives included in the run. For instance, we may know from the total array that there are ten times as many negatives as positives in a given run;[5] in this case a serum showing 3/6 deaths might be positive or negative with about equal probability.

By substituting the proper value of n in equation (11) it is possible to calculate the expected positive and negative distributions of test results read on the basis of four or five mice. This gives the elements of a chain binomial of the respective power arising from the curve of origin which was derived from the six-mouse results. The hypothetical

[5] The estimate of the proportion of positives in a run can be made by calculating "U" by the double binomial method. See Table IV.

distributions of results naturally vary with changes in the parameters of the curve of origin. These are not the same for any two of the four arrays of results which were analyzed, but the differences are too small to be of much practical importance in the evaluation of test results.

FIGURE 2
CURVES OF ORIGIN OF MORTALITY DISTRIBUTIONS

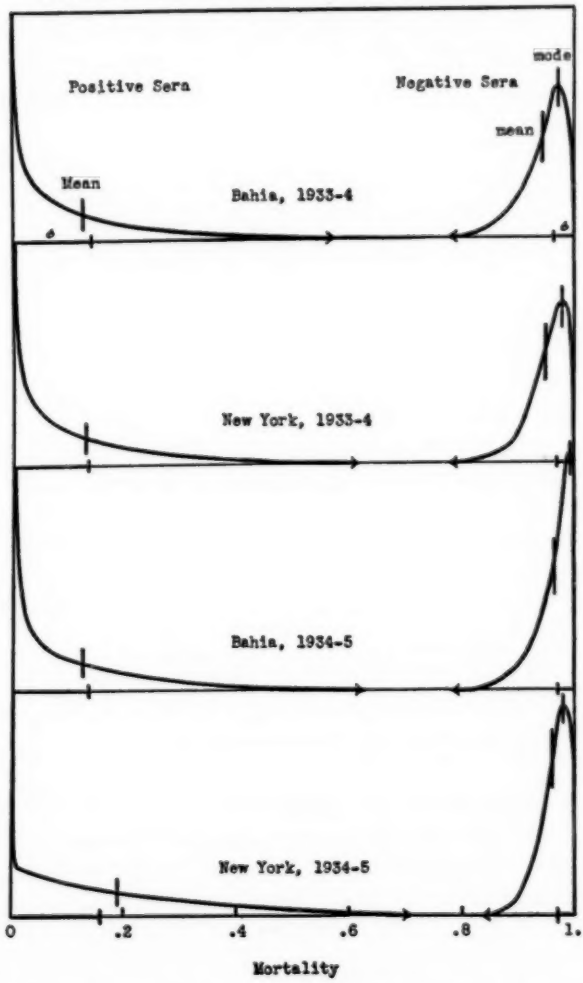


Table IV and Figure 2 show the characteristics of the eight curves of origin obtained from the four groups of tests. The standard deviations measuring the scatter of negative mortalities are much smaller than those of the positive mortalities. The modes of the former curves are appreciably below 100 per cent mortality. Mortalities in "unpro-

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Negative sera $y = 420.09p^{32.0547}(1-p)^{0.6940}$.

The last two lines of Table III show the relative expected frequencies of results for positive and negative sera on the basis of the above curves. These values are obtained directly from equation (11) and provide estimates of the probability of a given result being positive. It is evident that a negative serum will almost never show less than 3/6 deaths, while a positive rarely shows more than 4/6. In the intermediate zone, the probability would depend on the total number of positives included in the run. For instance, we may know from the total array that there are ten times as many negatives as positives in a given run;[5] in this case a serum showing 3/6 deaths might be positive or negative with about equal probability.

By substituting the proper value of n in equation (11) it is possible to calculate the expected positive and negative distributions of test results read on the basis of four or five mice. This gives the elements of a chain binomial of the respective power arising from the curve of origin which was derived from the six-mouse results. The hypothetical

[5] The estimate of the proportion of positives in a run can be made by calculating "U" by the double binomial method. See Table IV.

distributions of results naturally vary with changes in the parameters of the curve of origin. These are not the same for any two of the four arrays of results which were analyzed, but the differences are too small to be of much practical importance in the evaluation of test results.

FIGURE 2
CURVES OF ORIGIN OF MORTALITY DISTRIBUTIONS

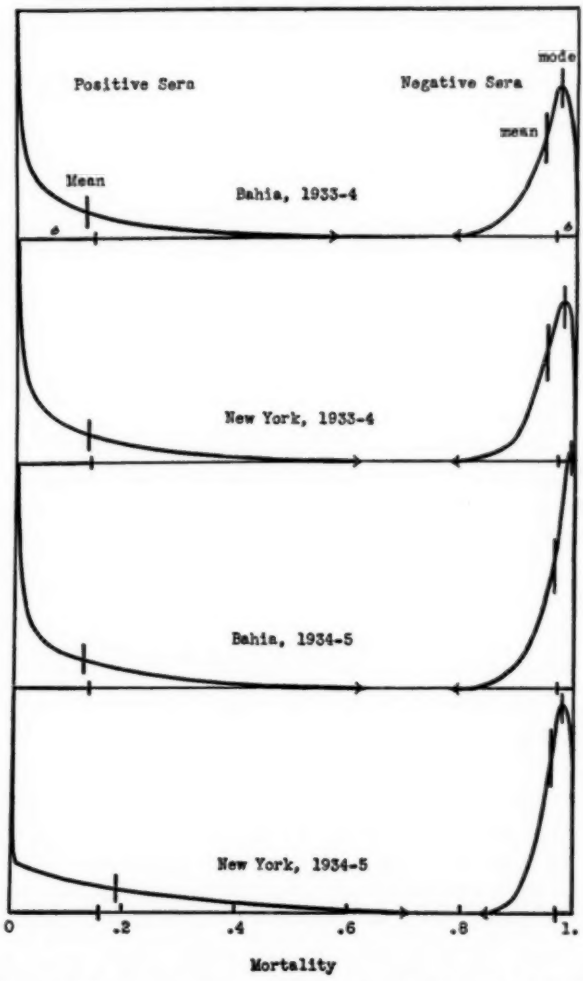

Table IV and Figure 2 show the characteristics of the eight curves of origin obtained from the four groups of tests. The standard deviations measuring the scatter of negative mortalities are much smaller than those of the positive mortalities. The modes of the former curves are appreciably below 100 per cent mortality. Mortalities in "unpro-

tected" mice have apparently risen and become more uniform (as indicated by a smaller σ) during the second year in both laboratories. This could be due to a rise in virulence of the virus employed, to changes in the technique of the test or to the use of more susceptible strains of mice.

The greatest frequency of positive mortalities is at zero. The constants of the different curves are much alike except for the last one, which shows a markedly greater spread. This might have been the result of the inclusion of a larger number of weakly protective sera in the runs during this year.

The scatter of negative mortalities reflects all experimental variations during the period. That of positives includes all these, plus variations in the protective power of positive sera. If we call the standard deviation of negative mortalities 3.5 per cent and that of positive 14 per cent (see Table IV), then the standard deviation due to the

TABLE IV

CHARACTERISTICS OF CURVES OF ORIGIN FOR "CHAIN BINOMIAL" FITS

Series	Mortalities among Mice Receiving:								Proportion of Sera Negative ("U")		Number of Tests
	Positive Sera				Negative Sera				Chain Binomial	Double Binomial	
	Mode	Mean	σ	π*	Mode	Mean	σ	p*			
Bahia, 1933–4	—	0.125	0.142	0.088	0.973	0.945	0.038	0.944	0.801	0.811	1507
New York, 1933–4	—	0.130	0.136	0.095	0.979	0.951	0.037	0.945	0.799	0.812	3061
Bahia, 1934–5	—	0.124	0.137	0.089	0.995	0.963	0.034	0.962	0.820	0.829	4641
New York, 1934–5	0.000	0.190	0.157	0.128	0.980	0.961	0.026	0.958	0.839	0.856	3062

* π and p values are those obtained by "double binomial" fit.

variation in positive sera alone would be $\sqrt{14^2 - 3.5^2} = 13.6$ per cent. The variation in test results introduced by differences in the protective power of pisitive sera is some four times as great as that due to all other factors together.

Included in Table IV is a comparison of the estimated proportion of negative sera ("U") as determined by the chain binomial and by the double binomial. The values are quite close. In each case "U" by the double binomial is slightly larger, *i.e.*, indicates a slightly lower proportion of positive tests in the entire group. From this it may be concluded that a reasonably accurate and rather conservative estimate of total positives may be obtained by the double binomial in the case of

runs which are too small to be broken down by successive approximations into chain binomials.

DISCUSSION

It is evident that the methods derived in this analysis apply equally well to criteria other than survival and death of the animals. This, however, is far the best when it can be used since it is one of the few that do not allow of variability of personal judgment. In any case, the criterion employed must permit only a simple yes-or-no decision.

Nor must the test animals necessarily be mice, though these offer many advantages in cost and in ease of handling. It would probably always be best to use as test animal the one which happened to be most susceptible to the infective agent studied. If this animal, however, turns out to be large and expensive, there can be no accumulation of large numbers of results based on test groups of fair size. At times, as was the case with yellow fever, it is possible to produce a strain of infective agent which is lethal to mice under given circumstances and yet is inhibited by sera of convalescents from attacks by the "free-living" strains.

It is apparent that the foregoing type of study cannot be made on an array of test results based on very small groups of mice. Even six-mouse groups, providing seven "fitting points," leave only one degree of freedom when two chain binomials have been fitted. Four-mouse groups are the smallest that can legitimately be analyzed by the double binomial method. But there would seem to be no good reason why mortality rates or distributions, once determined from arrays of large groups, could not be used to predict the distributions of positive and negative results based on smaller groups of test animals.

REFERENCES

[1] Sawyer, W. A., and Lloyd, W.: "The Use of Mice in Tests of Immunity against Yellow Fever." *Jour. Exper. Med.*, 1931, LIV, 533.

[2] Mahaffy, A. F., Lloyd, W., and Penna, H. A., "Two Years' Experience with the Intraperitoneal Protection Test in Mice in Epidemiological Studies of Yellow Fever." *Am. Jour. Hyg.*, 1933, XVIII, 618.

[3] Pearson, Karl: "On Certain Types of Compound Frequency Distributions in which the Components can be Individually Described by Binomial Series." *Biometrika*, 1915–17, XI, 139.

[4] Muench, Hugo: "Note on the Evaluation of the Results of Mouse Tests of Sera" in paper by Webster, Leslie T., Fite, George L., and Clow, Anna D.: "Specific Inactivation of Virus by Sera from Persons Exposed to Encephalitis, St. Louis Type, 1933." *Jour. Exper. Med.*, 1935, LXII, 829.

[5] Greenwood, Major, and Yule, G. Udny: "An Inquiry into the Nature of Frequency Distributions Representative of Multiple Happenings . . . " *Jour. Royal Statistical Soc.*, 1920, LXXXIII, New Series, 255.

THE IMPROVEMENT OF STATISTICAL TECHNIQUES IN BIOLOGY*

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1. THE DESIGN OF EXPERIMENTS

The entrance of the statistician into the field of experimental design is the most outstanding feature of modern statistics. No more than a decade past, the statistician was distinctly on the defensive. When the data from an experiment were placed on his desk, he was supposed to produce some method of treatment irrespective of design. In some instances he was lucky; in others, baffled. Under the leadership of R. A. Fisher, the statistician has become the aggressor. He has found that the key to the problem is the intimate relation between the statistical method and the experimental plan. The latter must be capable of producing not only an unbiased estimate of the desired effects, but also a valid estimate of error. Many of the plans in use did neither. The statistician is now able to assert that properly designed experiments yield unqualified answers to the questions asked. It is incumbent upon the investigator to plan his experiment in accord with established principles, if he wishes to avail himself of adequate statistical methods. Only if the plan and the method are compatible may unambiguous conclusions be drawn from the statistics. To insure this, the statistical method must be decided upon along with the experimental plan before the laboratory or field work is initiated. The integration of plan and method lead to efficient designs.

2. FACTORIAL DESIGN

Among experimental plans brought into prominence by appropriate statistical methods, one which has great logical as well as practical interest is that in which two or more factors in all combinations are investigated in the same experiment. Some description of such a factorial experiment will suffice to indicate its importance. The appropriate statistical methods are well known.

Professor C. S. Reddy of our Botany Department wished to try three levels of a disinfectant designed to destroy *diplodium* in corn seeds, each at three temperature levels. In addition, he wished to de-

* A paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.

termine the effectiveness of a substance intended to prevent injury of the seeds by the disinfectant, this inhibitor being also tried at three levels. In all combinations, there are $3\times3\times3=27$ treatments, and these are investigated simultaneously in the factorial experiment.

This is a great advantage over the separate trials of the treatments. If only the level of application of the inhibitor were to be varied, some specified amount of the poison at a particular temperature would have to be chosen. The level of inhibitor found suitable under these controlled conditions might be very inefficient under slightly altered conditions of control. The factorial design enables the investigator to determine the optimum combination of poison, inhibitor and temperature. Furthermore, by a method to be indicated in section 4 of this paper, it is easy to learn whether or not the effects are related to the levels in a linear fashion.

The general principles of factorial experimentation are, of course, not new. Recent advances in statistical theory have made clear the experimental plans that must be followed, and have made possible the extraction of much additional information from the results.

3. CONFOUNDING

In factorial experiments, when the number of treatments becomes great, the required plots in each block may be so numerous that soil heterogeneity within the block will seriously impair the accuracy of the experiment. The same difficulty would be met if a large number of animals were to be required, all being expected to react alike to uniform treatment. There is a possibility of alleviating this difficulty by dividing the replications into two or more blocks each containing part of the treatments. To a limited extent this may be done without sacrificing any desirable information. The dispensable effects are combined or confounded with block differences.

For illustration, an experiment has been chosen which, though rather oversimplified to be practical, nevertheless exemplifies all the essential principles. Suppose two varieties of maize are to be tested for yield, each treated with two kinds of fertilizer. The four combinations,

$$V_1T_1 \qquad V_2T_1 \qquad V_1T_2 \qquad V_2T_2$$

are to be replicated six times, requiring 24 plots. Suppose, further, that the field is of very uneven fertility so that even four plots, comprising one replication, cannot be placed on uniform soil. Precision may be increased by subdividing each replication into two blocks thus:

Block 1	Block 2
V_1T_1	V_1T_2
V_2T_2	V_2T_1

Notice that the assignment to block is along the diagonals of the plat of the four combinations. To understand clearly the effect of this allotment, let the yields of the four plots be denoted as follows:

Block 1	Block 2
y_{11}	y_{12}
y_{22}	y_{21}

If block 2 is of superior fertility, let the expected difference in block yield with uniform planting and treatment be $2d$. Then an unbiased comparison of the yields might be made in this manner:

Block 1	Block 2
$y_{11}+d$	$y_{12}-d$
$y_{22}+d$	$y_{21}-d$

If these results are now tabulated in an ordinary two-way table, they appear thus:

Variety	Treatment		Total
	T_1	T_2	
V_1	$y_{11}+d$	$y_{12}-d$	$y_{11}+y_{12}$
V_2	$y_{21}-d$	$y_{22}+d$	$y_{21}+y_{22}$
Total	$y_{11}+y_{21}$	$y_{12}+y_{22}$	

It is clear that, by the chosen arrangement, the block difference has cancelled in the totals, the varieties and treatments being properly compared with no bias. But the interaction carries a strong bias. Its value is

$$(y_{11}+d)+(y_{22}+d)-(y_{21}-d)-(y_{12}-d)=(y_{11}+y_{22})-(y_{21}+y_{12})+4d.$$

The correct value, $(y_{11}+y_{22})-(y_{21}+y_{12})$, is confounded with the unknown difference in yield attributable to fertility. By this arrangement, therefore, the estimate of interaction is lost, though the main effects are ascertained. If the interaction is of no interest, its loss is immaterial. The compensation comes from the greater precision of the experiment, since the block differences within the replications may now be eliminated from error.

The numerical results from a confounded experiment are recorded in Table 1. The total sum of squares for the 24 plots is computed from the plot yields and recorded in Table 2. The 12 block totals, two in each replication, yield the sum of squares for blocks. The unbiased

TABLE 1

YIELDS FROM 12 BLOCKS, EACH CONTAINING TWO PLOTS, FORMING SIX REPLICATIONS

Pounds per Plot

Block	Combination	Replication						Total
		1	2	3	4	5	6	
1	V_1T_1	11	5	12	15	22	6	71
1	V_2T_2	14	6	6	21	15	2	64
Block 1 total		25	11	18	36	37	8	135
2	V_1T_2	11	11	15	15	16	11	79
2	V_2T_1	12	8	8	11	11	11	61
Block 2 total		23	19	23	26	27	22	140
Replication total		48	30	41	62	64	30	275

total for variety 1 is $71+79=150$; for variety 2, $64+61=125$. These are used to compute the sum of squares for variety. In the same way, that for treatment is calculated from the treatment sums, $71+61=132$ and $64+79=143$. Ten degrees of freedom remain for error.

TABLE 2

ANALYSIS OF THE VARIANCE IN TABLE 1. FIRST ORDER INTERACTION CONFOUNDED WITH BLOCK DIFFERENCES

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	23	525.96	
Blocks	11	402.46	
Variety	1	26.04	26.04
Treatment	1	5.04	5.04
Remainder for error	10	92.42	9.24

On account of incomplete randomization in the replications it is impossible to know just what would have been the result if confounding had not been resorted to. It is interesting, however, to go through with the formal computations, with results recorded in Table 3. Insofar as the comparison may be valid, it is notable that the greater number of degrees of freedom for error carry more than a proportionately greater sum of squares. This might be due in part to the inclusion of block differences within the replications. It is also to be observed that the interaction, confounded with block differences in Table 2, is less than average expectation in Table 3.

In his new book, Fisher[1] calls attention to the fact that the ten degrees of freedom for error in Table 2 are composed of five from the six

[1] R. A. Fisher, *The Design of Experiments*. Oliver and Boyd, Edinburgh (1935).

TABLE 3
ANALYSIS OF THE VARIANCE IN TABLE 1 COMPUTED AS THOUGH THE COMBINATIONS HAD BEEN RANDOMIZED IN SIX BLOCKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	23	525.96	
Blocks	5	280.21	
Variety	1	26.04	26.04
Treatment	1	5.04	5.04
Interaction	1	1.04	1.04
Remainder for error	15	213.63	14.24

blocks numbered one and five from those numbered two. That is, each part of the estimate of error is made up from blocks planted alike. The computations are easily made from the data in Table 1. Among the 12 plots in the first half of the table, five degrees of freedom are assigned to replication and one to combination. The remainder, $11-(5+1)=5$, are identified with interaction, and yield the sum of squares, 69.42. Similarly, the interaction sum of squares from the second half is 23.00. The two make up the total of 92.42 appearing in Table 2.

It is believed that this exposition may serve to introduce the reader to the more extensive and practical designs discussed by Fisher and Yates.[2] In the simple scheme discussed here, there is only one way in which the confounding can be done. In the more elaborate designs, there is a choice. Usually, information about the first order interactions is desirable, and it is the interactions of higher order that are confounded.

4. INDIVIDUAL DEGREES OF FREEDOM

Professor Fisher has insisted that degrees of freedom are individual entities, each with a meaning that may be isolated if interesting. Usually, the separation of a group of degrees of freedom into its component parts is not unique, but the method employed should have a definite objective and should lead to interpretable results. In an important special case, the mechanics of the process are greatly simplified by Fisher's elegant method of fitting curved regression lines.

Dr. A. E. Brandt of our laboratory has furnished me with an illustration of an analysis which I think is destined to play an important rôle in experimentation with dairy cows. The effect of any treatment presumed to affect milk flow is complicated by the normal cycle of production. To meet this difficulty, the treatment is applied periodi-

[2] F. Yates, "Complex Experiments," *Supplement to the Journal of the Royal Statistical Society*, 2: 181 (1935).

cally, the results being compared with those from the untreated interperiod. More usually, two treatments are alternated in the periods and their effects compared. The data from such an experiment are recorded in Table 4. The analysis of the variance, Table 5, is computed in the usual manner.

TABLE 4

AVERAGE DAILY MILK PRODUCTION (POUNDS) OF FIVE COWS IN THREE EXPERIMENTAL PERIODS DURING WHICH INDICATED RATIONS WERE FED

Cow Number	Period 1 High Fiber	Period 2 Low Fiber	Period 3 High Fiber	Total
855	25.92	20.84	18.84	65.60
867	46.10	41.26	26.42	113.78
943	43.28	32.80	28.12	104.20
1039	44.54	39.54	34.08	118.16
1066	57.62	45.84	35.70	139.16
Total	217.46	180.28	143.16	540.90

It is clear that the interest of the investigator lies in the linearity or non-linearity of the milk production in the three periods. If the change of treatment had any effect, it must be revealed by the failure of the production in the middle period to fall on the regression established by the beginning and final periods. The appropriate tests of significance are got by dividing the two degrees of freedom for period

TABLE 5

ANALYSIS OF VARIANCE OF DAILY MILK PRODUCTION OF FIVE COWS IN THREE EXPERIMENTAL PERIODS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	14	1,626	
Between cows	4	973	243
Between periods	2	552	276
Interactions	8	101	13

into one representing linear regression and one for deviations from such regression, then making a corresponding division of the 8 degrees of freedom for interaction. The results are presented in Table 6. Two tests of significance may be made: (i) Between periods, linear regression, against interactions, linear regression; $F = 552/19 = 29$, a significant value, but uninteresting in this case. There is never any question about the decrease of milk flow with advance of the reproductive cycle. (ii) Deviations in the two sources, $F = 0$. This is the important information desired. The change in rations had no appreciable effect.

5. CORRELATION ATTRIBUTABLE TO COMMON ELEMENTS

This is certainly not a new subject, but may well be given more, and more serious, consideration than heretofore. The earliest publication I have found is in an article by Spearman.[3] However, this method of explaining correlation seems to have been used at or before that

TABLE 6

ANALYSIS OF THE VARIANCE BETWEEN PERIODS AND INTERACTION IN TABLE 5 INTO TWO PORTIONS EACH, ONE FOR LINEAR REGRESSION AND THE SECOND FOR DEPARTURES THEREFROM

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Between periods:			
Linear regression	1	552	552
Deviation	1	0	0
Interactions:			
Linear regression	4	77	19
Deviations	4	24	6

time by Weldon,[4] being referred to in Brown's doctorial dissertation[5] as "Weldon's experiment." Aspects of the theory have been discussed by Kapteyn,[6] Brown and Thomson[7] Rietz,[8] Karl Pearson,[9] Carl H. Fischer,[10] and others. Rather inadequate references to it have recently appeared in several elementary texts. I am convinced that many ill-founded ideas, almost superstitions, about correlation will be abandoned when this interpretation is more generally understood.

Consider a population of numbers. For simplicity, they may be normally distributed, though Carl Fischer has shown that the distribution may be described in more general terms. For convenience, also, let the mean be zero and the standard deviation, unity. Draw a random sample of N of these normal deviates, thus:—

$$V_1, V_2, \cdots, V_{N-n_2}, V_{N-n_2+1}, \cdots, V_{n_1}, \cdots, V_N .$$

Designate by x_1 the sum of the first n_1 of these items, and by x_2 the

[3] C. Spearman, "The proof and measurement of association between two things," *American Journal of Psychology*, 15: 72 (1904).

[4] W. F. R. Weldon, "Inheritance in animals and plants," in *Lectures on the Method of Science*. Edited by T. B. Strong. Clarendon Press, Oxford (1906).

[5] William Brown, *The Essentials of Mental Measurement*. The University Press, Cambridge (1911).

[6] J. C. Kapteyn, "Definition of the correlation-coefficient." *Monthly Notices of the Royal Astronomical Society*, 72: 518 (1912).

[7] William Brown and G. H. Thomson, *The Essentials of Mental Measurement*. The University Press, Cambridge (1921).

[8] H. L. Rietz, "A simple non-normal correlation surface." *Biometrika*, 24: 288 (1932).

[9] Karl Pearson, "Professor Rietz's problem." *Biometrika*, 24: 290 (1932).

[10] Carl H. Fischer. "On correlation surfaces of sums with a certain number of random elements in common." *The Annals of Mathematical Statistics*, 4: 103 (1933).

sum of the last n_2. Assuming that $n_{12}=n_1+n_2-N$ is a positive number, then n_{12} of the elements are common to the sums x_1 and x_2. Repeat this process *ad libitum*. The correlation between x_1 and x_2 is,

$$r_{12} = n_{12}/\sqrt{n_1 n_2}\,,$$

and the regression of x_1 on x_2 is,

$$\bar{x}_1 = (n_{12}/n_2)x_2\,.$$

Further, n_1 and n_2 are the variances of x_1 and x_2.

To extend the above ideas to include multiple regression, the random sample may be subdivided into three groups of items whose sums are x_1, x_2 and x_3, with n_{12}, n_{13} and n_{23} random elements common respectively to x_1 and x_2, x_1 and x_3, x_2 and x_3. It can then be shown that the correlations are of the form,

$$r_{12} = \frac{n_{12}}{\sqrt{n_1 n_2}} + \frac{n_{13}}{\sqrt{n_1 n_3}} \cdot \frac{n_{23}}{\sqrt{n_2 n_3}}\,,$$

the extra term being due to the elements passing from x_2 to x_1, not directly, but through x_3. Furthermore, the standard regression coefficients are like this,

$$\beta_{12.3} = n_{12}/\sqrt{n_1 n_2}\,,$$

and the regression equation may be written,

$$\begin{aligned}\bar{x}_1 &= \frac{n_{12}}{\sqrt{n_1 n_2}} \cdot \frac{\sqrt{n_1}}{\sqrt{n_2}} \cdot x_2 + \frac{n_{13}}{\sqrt{n_1 n_3}} \cdot \frac{\sqrt{n_1}}{\sqrt{n_3}} \cdot x_3 \\ &= (n_{12}/n_2)x_2 + (n_{13}/n_3)x_3\,.\end{aligned}$$

I can merely suggest the type of inquiry now laid open to investigation. First, consider the moot question as to the "determination" of x_1 by x_2 and x_3. Ezekiel[11] suggested the quantities $r_{12}\beta_{12.3}$ and $r_{13}\beta_{13.2}$ as "coefficients of separate determination," since their sum is $R^2_{1.23}$. But, in terms of common elements, these are complicated expressions, in no way specifying the numbers of elements common to the dependent and independent variables. Again, Wright[12] presented a "coefficient of determination," $\beta^2_{12.3}$, but later withdrew the suggestion.[13] Wallace and Snedecor[14] used merely the standard regression coeffi-

[11] Mordecai Ezekiel, *Methods of Correlation Analysis*. John Wiley and Sons, Inc., New York. Page 380 (1930).

[12] Sewall Wright, "Correlation and causation," *Journal of Agricultural Research*, 20: 557 (1921).

[13] Sewall Wright, "The method of path coefficients," *Annals of Mathematical Statistics*, 5: 165 (1934).

[14] H. A. Wallace and George W. Snedecor, "Correlation and machine calculation," *Iowa State College Official Publication*, 30: No. 4 (1931).

cients; but these give the information desired only if $n_1=n_2=n_3$. It turns out, however, that the assumption of the equality of these numbers is usually necessary in order to identify the method of common elements with any actual situation. Apparently, these standard regression coefficients are as good an estimate as any available for judging the relative potency of x_2 and x_3 in affecting x_1, but the idea should be used with due caution as to its limitations.

Another interesting interpretation of correlation is Wright's[15] coefficient of determination of outside causes, $d_{x\cdot o}$. In the simple case of two variables, this is $1-r^2_{12}$, which for common elements is $1-n^2_{12}/n_1n_2$. I have tried to identify this with some function of the non-common elements, n_1-n_{12} and n_2-n_{12}, but have not succeeded in the general case. In two particular cases, the results are interpretable. (i) If all the elements in x_2 pass to x_1 then $n_2=n_{12}$, and consequently $d_{x\cdot o}=1-n_{12}/n_1$, the fraction of elements in x_1 not common to the two variables. (ii) If all the elements in x_1 are received from x_2, then $d_{x\cdot o}=1-n_{12}/n_2$, the fraction of elements in x_2 not passing into x_1. The interesting feature of these interpretations is that the outside influences may enter the system either through x_1 or x_2, but not through both. With more than two variables, the situation becomes much more intricate.

An example of a common interpretation of correlation which is, in a special case, justified by the theory of common elements is the statement that, "The correlation r_{12} is the fraction of causes common to x_1 and x_2." The special case is that mentioned before, in which the number of elements is assumed to be the same in x_1 and x_2. If $n_1=n_2$ then $r_{12}=n_{12}/n_1$. When using this interpretation, it should be understood that the "causes" are not only equal in number, but must be of uniform weight in the sense that they must be random elements in a specifiable population.

6. TESTING IN COVARIANCE

There was a tremendous spurt of interest in covariance beginning a couple of years ago. Correlation method always excite the imagination. Methods of testing crowded each other's heels; Bartlett,[16] E. S. Pearson,[17] Welch,[18] and Wishart[19] published in rapid succession, while

[15] Sewall Wright, *loc. cit.* (1921).

[16] M. S. Bartlett, "The vector representation of a sample," *Proceedings of the Cambridge Philosophical Society*, 30: 327 (1934).

[17] Appendix to paper by E. S. Wilsdon, "Discrimination by specification statistically considered and illustrated by the standard specification for Portland cement." *Supplement to the Journal of the Royal Statistical Society*, 1: 180 (1934).

[18] B. L. Welch, "Some problems in the analysis of regression among k samples of two variables," *Biometrika*, 27: 145 (1935).

[19] John Wishart and H. G. Sanders, *Principles and Practice of Field Experimentation*. The Empire Cotton Growing Corporation, London (1935).

Fisher's revised text[20] included the test appropriate to certain planned experiments. It seemed that the complications would be almost too great to be mastered by the layman. Numbers of hypotheses were set up, each requiring its appropriate test. It was with much trepidation that I suggested the simple form outlined in my paper at the last meeting of this Association.[21] It seems, now, that this easy method has rather wide application. It may be used at least in a preliminary examination, to be followed by more specialized tests if required. However, we have tried it in numerous analyses during the past year, and have found it adequate. The problem of testing in covariance seems to be about solved. Fortunately, the non-professional user of statistics may proceed with almost the same security as he feels in testing variance. When working with data from a planned experiment, such as a block-variety or Latin square, he should use the appropriate method as given in Fisher's book. In preliminary studies of correlated data from casual sources, he should use the method which I proposed last winter. If critical questions arise, he may be compelled to test some of the more specialized hypotheses given in the references listed.

7. FACTOR THEORY

You may be surprised to hear this theory mentioned in connection with biological statistics. Professor Thurstone suggested to us that it might have applications other than the examination of test scores. We have used it in an investigation of a group of correlations among various characters in soybean plants, including height, numbers of nodes and pods, seeds per pod and yield. When Weatherspoon and Wentz[22] published these data, they made the suggestion that all the variates probably were expressions of plant vigor. Miss Gertrude M. Cox of our laboratory has applied the factor theory to the correlations with some interesting results.

Three rather well defined general factors segregate. (i) Vegetative growth, highly correlated with height and number of nodes. This is the character most sensitive to environmental conditions. (ii) Reproduction, with its associated variates, number of pods, and pods per node. This is another physiological character, dependent upon environmental conditions for its initiation, but responding to a different set of internal conditions from that favoring the first factor. (iii) Inherited characteristics such as seed size and seeds per pod. These respond less

[20] R. A. Fisher, *Statistical Methods for Research Workers*. Oliver and Boyd, Edinburgh (1934.)

[21] George W. Snedecor, "Analysis of covariance of statistically controlled grades," This JOURNAL, 30: 263 (1935).

[22] J. H. Weatherspoon and J. B. Wentz, "A statistical analysis of yield factors in soybeans," *Journal of the American Society of Agronomy*, 26: 524 (1934).

freely to environment, being under ordinary conditions almost independent of it.

In this analysis, yield turns out to be a factor common to, and positively associated with all the others. It partakes freely of both environmental and hereditary influences. The three general factors, however, are rather sharply differentiated in their relationships. I am indebted to Dr. W. E. Loomis, plant physiologist of our Botany Department, for the interpretation of these results. Apparently, the elaborate numerical analysis associated with the factor theory is capable of isolating something objective, and this is welcome information. Whether the method will have any practical applications in biology, I cannot say.

We have another interest in the factor theory. With the mechanism of common elements at hand, using a technique similar to that of Brown and Thomson,[23] we could design a set of variables correlated with each other in a known manner, or independent of each other; also correlated with both general and specific factors in the same predetermined fashion. Miss Cox then applied Thurstone's method, obtaining completely satisfactory verifications of the theory. The determination of the factors is, of course, approximate; but the precision was most pleasing. Incidentally, the whole process of setting up and solving the problem by common elements was of indispensable educational value to us.

8. THE REJUVENATION OF CHI-SQUARE

No review of the improvement of statistical techniques in biology would be complete without mention of the advances made during recent years in the utility of chi-square. Designed by Karl Pearson[24] for a highly specialized purpose, it has, in the hands of R. A. Fisher, become the basis of a statistical method of major importance. Fisher says,[25] "This, I believe, is the great contribution to statistical methods by which the unsurpassed energy of Professor Pearson's work will be remembered." It is coming to be generally recognized that chi-square is the test of significance appropriate to the enumeration data characteristic of the study of attributes. To convert such data into percentages or other ratios and study them as measurements of a continuous variate is not only to substitute an approximate method for an exact one, but is to waste a lot of good information contained in the data. Analysis of enumeration data with the aid of chi-square is almost as systematically done as analysis of variance.

[23] William Brown and G. H. Thomson, loc. cit., p. 696.

[24] Karl Pearson, "On the criterion that a given system of deviations . . . can be reasonably supposed to have arisen from random sampling," *Philosophical Magazine*, Series 5, 50: 157 (1900).

[25] R. A. Fisher, *loc. cit.*, page 23 (1934).

I shall illustrate my point through means of some data, Table 7, made available to me by Mr. J. F. Kagy of our Zoology Department. He was investigating the effects of three insecticides applied to San José scale. The insects infested branches of apple trees near Ames, Iowa. Each branch was cut into three segments, one of which was treated with each of the insecticides. If analysis of variance were used, the assumption would have to be made that the second order interaction is a valid estimate of error. The proper analysis, by means of chi-square, requires a method for isolating this second order interaction, a problem which has been solved only for a special case.[26] However, a comparatively simple approximation seems ample to indicate a sig-

TABLE 7

ACTUAL AND ESTIMATED NUMBERS OF SAN JOSÉ SCALE KILLED BY THREE INSECTICIDES IN SUBSAMPLES OF 60, TOGETHER WITH VALUES OF CHI-SQUARE*

Segment	Insecticide A			Insecticide B			Insecticide C			Total	
	Dead	Estimated	χ^2	Dead	Estimated	χ^2	Dead	Estimated	χ^2	Dead	χ^2
1	32	30.630	0.06	47	45.589	0.04	51	53.781	0.14	130	0.25
2	39	34.635	0.55	51	51.551	0.06	57	60.814	0.24	147	0.85
3	38	33.929	0.49	51	50.498	0.01	55	59.573	0.35	144	0.84
...	...	...	...	...	...	...	...	...	...	...	...
17	30	28.038	0.14	37	41.731	0.54	52	49.230	0.16	119	0.83
Total	516		10.04	768		4.36	906		4.67	2,190	19.06

* From data furnished by J. F. Kagy of the Zoology Department of Iowa State College.

nificant heterogeneity in the present data. Each sub-class in the table is supplied with an expected number by known methods.[27] The same is done for the numbers alive. Usually, the two expected numbers, dead and alive, do not add to the required 60 insects, so that an adjustment must be made to remedy this difficulty. Then the contributions to chi-square are calculated in the usual manner. The resulting sum, 53.4 based on 32 degrees of freedom, has a probability of occurrence in random samples from a homogeneous population of only 1.6 per cent. Although the amount of heterogeneity in this case is apparently not serious, and although analysis of variance yielded much the same tests of significance as did chi-square, it is to be hoped that a practicable method may be forthcoming for the exact estimation of interaction in such a three-way table.

[26] M. S. Bartlett, "Contingency table interactions," *Supplement to the Journal of the Royal Statistical Society*, 2: 248 (1935).

[27] George W. Snedecor, "The method of expected numbers for tables of multiple classification with disproportionate subclass numbers," This JOURNAL, 29: 389 (1934).

INDUSTRY STATISTICS IN MARKETING MANAGEMENT

By S. J. Kennedy
Pacific Mills

Opportunities for the use of industry statistics in determining marketing and production policies are exceptionally numerous in the textile industries because of the character of the dominant supply and demand factors in textile markets. Properly speaking, there is no "textile industry" nor even a "cotton textile industry" in the sense that industry statistics for such large groupings have much genuine usefulness to individual firms in the industry. Economists on the outside may find some use for statistics of that type, but what cotton mill management needs—and probably the same is true in other industries as well—are statistics for much finer groupings; in short, statistics which indicate current conditions and trends in specific markets. In the textile trades, the term "market" is generally applied to the buyers and sellers of a group of fabrics closely related in character and produced upon the same specific equipment, or by the same type of mills, which tend to be sold interchangeably to more or less the same group of purchasers. In the cotton woven goods branch of the industry, for example, there are approximately 150 individual markets, 35 grey goods markets, about 60 finished goods markets, and about 50 fabricated product markets.

Following this concept further, it can be seen that the textile industries as a whole comprise a system of interrelated markets closely held together by strong tendencies on the demand side toward substitution of one fiber for another, and of one fabric for another; and on the supply side by the potential transferability of a large part of the total equipment in the industry from producing goods sold in one market to products of other markets. This interrelationship contributes to a high degree of elasticity of supply and demand for certain types of goods, while for other types, supply and demand may be highly inelastic.

In either case, it is of the utmost importance for management to have statistical data on supply and demand conditions in the particular markets for which its products are intended. Not that without such statistics management would be unable to act, for statistics are frequently not available in sufficient time to indicate market trends, but to confirm quantitatively trade reports of a qualitative nature which must frequently be the sole basis for marketing decisions.

For the analysis of short-term supply and market demand, Trade Association statistics of production, stocks, unfilled orders and shipments have come to be invaluable guides to management, even in the textile industries. There are, of course, still a substantial number of mill executives whose management methods are too completely guided by hunches for them to see a dollars-and-cents value in industry statistics above the small cost of reporting their own figures. In some branches of the textile industry, the percentage of firms unwilling to report statistical data to the Trade Association is large enough to affect seriously the value of such industry statistics. There the periodical biennial check afforded by the Census of Manufactures production figures is invaluable as an indication of the real significance of Trade Association data for any given specific market.

With statistics of current market conditions as revealed in weekly Trade Association data, we are less concerned here than with industry statistics of a long-term character which may be used for determining basic trends in distribution both in the demand for specific products and the channels of distribution for those products.

Statistics of unfilled orders and stocks on hand are invaluable for analyzing market demand factors for short-term periods, but throw little light upon consumer demand which is essentially long-term in its operation, and for purposes of marketing control is frequently the more important aspect of demand. In the final analysis, consumer demand for fabrics to satisfy textile uses is met by the products of a number of different fibers: cotton, silk, filament rayon, spun rayon, wool, jute, paper, etc. Continual shifts are taking place between these fibers, due in part to competition between them based upon both price and consumer preference. In addition, within the group of fabrics produced from the same fiber, continual shifts are occurring from one fabric to another, due to style trends and price bracket requirements.

The determination of these trends in substitution is a fundamental problem in textile marketing management. Markets may either be shrinking in size or growing. Complete dependence upon trade contacts and trade news for information about relative trends in markets may be adequate for a small converter with only limited capital and a handful of customers, but for a large organization with heavy fixed investment, a more complete picture of the market which can be confirmed statistically is definitely needed.

From a production management point of view, the need for this information is further enhanced by the transferability of a large part of the total producing equipment in the industry to the products of other markets. It is probable that in the cotton woven goods branch of the

industry, as many as two-thirds of the looms can be converted to producing other types of products than those on which they normally operate, with only a moderate amount of readjusting required. For mills with specialized equipment which can produce only a limited range of merchandise, the need for adequate information on long-term market trends is even more necessary.

Furthermore, trade news is frequently subject to propaganda used to bolster up the confidence of retail and consumer channels in types of goods for which the consumer market is actually shrinking. In a declining market a mill may be obtaining a continually increasing share of the total market so that the fundamental downward trend may not be apparent, and as a result, the mill may overstay the market, continuing to produce goods at a rate unjustified by the decreasing size of the market. The fact that the market appears to be continuing on an even level may deceive the management and lead it to stay on in the field while its competitors may have shifted to more profitable lines.

On the other hand, a firm may be losing business in a specific market at a rate faster than the actual decline of the market, with the result that the management may tend to attribute its poor merchandising job to lack of demand for goods of that type. Based on such conclusions, a shift of producing equipment to other products or the actual shutting down of the mill may be undertaken prematurely. Conversely, in a growing market a mill which is holding its own or increasing its volume at a lower rate than the actual expansion of the market, may feel that it is doing a good job, whereas actually it should be doing a much better merchandising and selling job.

In the past it has been exceedingly difficult to obtain significant statistics which would reveal market trends, or even to lay bases for estimates that would reveal trends. However, in the last few years, definite and important progress has been made in improvement of this data and the basis has been laid for further compilation of significant data on specific textile markets. Statistics of total production in specific textile markets will be available when the 1935 Census of Manufactures data are published. These data, together with trade association statistics of production in those markets, will provide a body of data which can be used for this type of analysis such as this industry has never had available before.

This same line of approach can frequently be used to determine not only the existence of certain trends in the shrinkage or growth of a given market, but also upon careful analysis, to indicate the causes of those trends. To indicate, for example, that the rayon dress fabric

market among manufacturers producing dresses to wholesale at $2.25 to $3.75 each is expanding along certain measurable lines is not enough. Where is the consumer demand coming from? Is the dress market getting a larger share of the consumer dollar? Or if consumer income is increasing, is the share going to the dress market simply proportionate to this increase? Or is a substitution of rayon fiber for cotton, silk, and wool occurring, and if so, to what extent is each being affected by growth in the demand for rayons?

Unless competition in a broad market like the women's dress fabric market is direct, the existence of competition between one fiber and another may not be detected for a long time. For example, as has recently been determined, the expansion of filament rayon consumption took place at the expense of cotton far more than at the expense of silk; but since its competition with cotton was indirect—that is, not on a price basis, so much as on a use basis, with a rayon dress substituting for one or more cotton dresses even though the latter were selling at a lower price, since a rayon dress is usable for more occasions and a longer period during the year—the cotton goods market was not aware of the extent of this consumer substitution even though there was a vague feeling that demand for their product was being curtailed. Likewise, the current expansion in spun rayon fabrics will undoubtedly occur over the near future in much the same manner—that is by indirect competition. Probably wool and cotton will feel this competition most severely, but since the price ranges in which spun rayon garments will be sold will be higher than those of cotton and much lower than those for wool, it will be difficult for producers of those two types of goods to get at grips, so to speak, with this competition and to know to what extent this new fiber is cutting in on their markets.

It is for the solution of such problems which involve fundamental marketing and production policies that industry or market statistics have their greatest value. Study of trends in a number of closely related markets will frequently reveal the extent, character and cause of shifts from one to the other.

But beyond the problem of trends in the market itself is the closely related problem of trends in channels of distribution. Just now in the department store field there are endless conferences being conducted to discuss the decline of piece goods sales. If one-tenth or even one per cent of the money represented by the time of high priced executives who get together to discuss this problem were invested in worth-while statistics by some one interested in them not as propaganda for some previously determined course of action, we would soon have the data needed to know what is actually happening in the piece goods field,

where it is occurring and how to go about correcting it intelligently.

If such statistics of trends in distribution channels of specific markets were made available, we should perhaps be spared the welter of argument over trends in dry goods wholesaling. Over the past ten years there has been enough discussion of the decline of dry goods wholesaling to fill a good sized library. Just recently we have witnessed an amazing attack in the press upon wholesale dry goods distribution by a leading chain store executive and a reply by a wholesaler whose use of statistics in his reply was not less amazing. The facts, of course, are somewhere in between, but it would be a relief to have them available so that there would be something more definite for laymen to go by.

In the field of distribution, a worth-while start has been made by the Bureau of Census in what is now called the Census of Business. Whereas production data collected by the Census are fairly well supplemented by trade association statistics within the limitations indicated above, there is little available among textile trade associations in distribution statistics. From time to time associations like the Cotton Textile Institute and the former Wool Institute have attempted to collect data in this field, but either lack of funds or unwillingness of many firms to keep statistics of their own on distribution, or the complexity of the textile market system itself has militated against the collection of a significant body of data on distribution in practically all textile markets.

Here the same selling job which trade associations originally had to undertake to convince their members of the value of production statistics must eventually be undertaken with distribution statistics where the benefits are more in the long run rather than nearby, whereas textile executives never have been and are not now accustomed to basing judgments habitually upon long-term values. The educational work on the value of statistics accomplished during the code period under intelligent leadership in the various branches of the industry undoubtedly laid a foundation for future expansion in the use of textile statistics.

The use of industry statistics for determining long-term market trends in demand for specific products and in channels of distribution along the lines which have been indicated above, represents only one, but an important application of statistics dealing with specific industries or markets.

It must be realized, however, that for valid conclusions to be drawn, the basic data, must be expressed in terms of totals for the industry, not samples, since the number of firms represented is seldom large

enough, nor their production uniform enough for it to be possible to estimate the total from any arbitrarily selected sample. It is for this reason that industry data compiled by Trade Associations must be continually checked, even though tardily, against totals collected by the biennial Census of Manufactures. Without such periodic check in terms of totals, this type of industry analysis, which has been outlined above, becomes impossible. Accordingly, for the Census of Manufactures to serve its most useful purpose in this field, its classifications must be similar to the classifications used by accredited Trade Associations in their respective fields.

Proposals to make the Census of Manufactures product data less detailed than is required to show production in the industry's separate markets, or to issue it less frequently, would diminish its usefulness in more than geometrical proportion to the extent of the reduction made. If industry cannot obtain the kind of product data that has a definite meaning in terms of industry statistics, the collection of data in broader classifications represents simply a waste of time and money both on our part and the Government's.

It is of the highest importance, if Government agencies are to justify the continual collection of statistics from industry for whatever purpose, and the substantial expenditures which they require of reporting firms, that a genuine effort be made, first, to see that the data will serve a definite constructive end, and second, that the results will be of direct value to those who furnish it. The extension of these principles among Government agencies will go a long way toward diminishing some of the feeling of futility which generally overwhelms those who have to fill out Government questionnaires. Far more important, if coupled with prompt and complete publication of the reported data, it will facilitate definite progress in the collection of a type of statistics that industry is coming more and more to value.

DEVELOPMENT OF THE POSTAL SAVINGS SYSTEM

By Louise Sissman

The United States Postal Savings System was established in 1911 after continued agitation for half a century. It was originally proposed as a charitable institution for fostering thrift among the poor and later was urged as a means of attracting the savings of immigrants and of hoarders who either were too awed by the elaborate bank buildings to feel their small savings would be welcome or who actually distrusted the safety of the banking institutions. The panic of 1907 greatly augmented the group distrusting the banks and the demands for a government guaranty of bank deposits or, as a substitute, a government guaranteed depository, gave very considerable weight to the movement for the introduction of a Postal Savings System.

Nevertheless, the Postal Savings System did not immediately become popular. After a year and a half of activity, less than 245,000 persons had availed themselves of the facilities of the System and, although during the next few years depositors continued to increase steadily, the movement was anything but spectacular. By 1917 the number of depositors reached a peak of 675,000 persons and then actually began a decline which was at first almost as steady as the growth in the previous years. As a result, in 1930, after twenty years of operation the number of depositors was only 466,000. At the same time the owners of bank savings accounts numbered 52,000,000.

The movement in deposits was similar. Despite several relaxations of the law limiting the amount receivable from one person, the amount on deposit grew so slowly that by 1930 it was only $175,000,000, less than one per cent of the $27,000,000,000 of savings deposits then in banks. For the country as a whole, in 1930 bank savings deposits averaged $221 per inhabitant, while Postal Savings accounts averaged less than $1.50.

Suddenly, in 1930 this lethargy vanished and within three years the Post Office witnessed the growth of its depositors to 2,342,000 and its deposits to $1,187,000,000 increases of 400 per cent and 575 per cent, respectively. These changes are shown in Chart I.

IMPORTANCE OF POSTAL SAVINGS

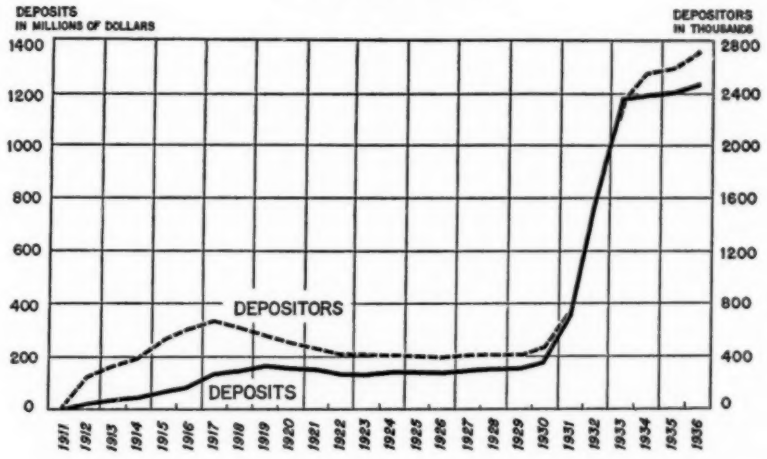
Despite this rapid development the Postal Savings System is still of relatively small importance when considered as a type of savings in-

stitution. It has only 6 per cent of the savings depositors in the country and 5 per cent of the savings deposits. The 571 mutual savings banks have eight times the deposits held by the Post Office.

CHART I

POSTAL SAVINGS DEPOSITS AND DEPOSITORS

June 30, 1911–June 30, 1936



When, however, the Postal Savings System is viewed as a single organization with centralized control, the Post Office stands out clearly as our largest single organization for the collection of savings deposits.

TABLE I

POSTAL SAVINGS SYSTEM AND BANKS RECEIVING SAVINGS DEPOSITS

June 29, 1935

Class of institution	Number of offices		Amount in savings deposits (000,000 omitted)	Number of savings accounts
	Head offices	Branches		
Postal Savings System	1	8,036*	$1,202	2,587,128
Mutual savings banks	571	133†	9,902	13,213,211
National banks	5,431	1,327†	6,363	14,338,780
State banks	8,460		2,509	6,810,471
Stock savings banks	341	1,772†	715	1,359,414
Loan and trust companies	1,007		2,309	4,723,553
Private banks	243	3†	41	32,186

* Post Offices and branches designated to receive Postal Savings deposits.

† December 31, 1935.

Source: Number and amount of savings deposits in banks—*Annual Report of the Comptroller of the Currency for 1935*, pp. 116–121.

Number of banks—*Ibid.*, p. 100.

Number of branches—*Federal Reserve Bulletin*, April, 1936, p. 304.

Note: Statistics of Postal Savings throughout this paper are based on data in the annual reports of operation of the Postal Savings System and are for the Continental United States only.

Its nearest rival is the Bowery Savings Bank whose total deposits amount to $500,000,000, less than half that of the Postal Savings System. Nor can any banking organization compare with the Post Office in geographic importance. While the issue whether banks should have branches has been contested in practically every state of the Union, the Post Office has quietly established an unsurpassed branch savings system. With offices located in cities large enough to have hundreds of banks and in hamlets too small to support even one bank, the Postal Savings System is able to reach more customers than any other financial organization. In many communities it is the only institution available for the collection of savings.[1] In 1935 the Post Office had more than 8,000 offices providing facilities for savings accounts in over 7,200 communities in every State. The largest branch banking system, the Bank of America, N. T. & S. A., on the other hand, had about 430 branches active in one state only.

With such a large nation-wide system, many of the problems inherent in a branch organization are present in magnified form. Branch systems have been accused of draining funds from local communities; of encouraging investments in securities as opposed to local loans; of being rigid in their regulations which are relatively uniform for all offices, sometimes without regard for exceptional local conditions; of tending to become bureaucratic; and of offering unfair competition to local business due to their size. Up to 1933 most of these problems were dormant in the Postal Savings System. Postal Savings funds were in the main redeposited in local banks, thereby becoming indirectly deposits in either local banks or relatively small branch systems which could make the money available to local communities through loans. Since 1933, however, the banks have in considerable numbers begun to refuse Postal Savings funds and the biggest part of the money has been transferred to Washington for investment in securities. This has brought to life many of the issues involved in a branch system.

Because the law has restricted the lines of activity of the System, these questions have not as yet become acute. Nevertheless they seriously merit study. The set-up of the System is such as to render it readily available for an extension of powers should Congress decide to do so. The potentiality for rapid growth, moreover, which was demonstrated by the sudden rise in three years from deposits of $175,000,000, to $1,187,000,000, without any advertising, demonstrates that Postal Savings may quickly and readily be used to exercise considerable influence in our banking system. For these reasons it is well

[1] In 1934 there were Postal Savings depositories in about 2,250 communities which either had no bank or no bank whose deposits were insured by the Federal Deposit Insurance Corporation.

to study the Postal Savings System with a view to directing intelligently its future operations. This particular article is confined to an analysis of the changing type of Postal Savings depositors and the principal factors which have brought about this change.

CHANGING CHARACTER OF POSTAL SAVINGS

The rapid increase in Postal Savings deposits during the period 1930–1933 has been attributed to the bank failures of that time and appears to be in direct contrast with the preceding decade during which Postal Savings showed little change. What has not been recognized is that the forces which brought about this sudden growth were at work during earlier years. A close examination of the statistics of the period prior to 1930 discloses that Postal Savings were undergoing important changes throughout the country for at least a decade but these changes were obscured by the existence of opposing local trends which counterbalanced each other and were, therefore, hidden in the totals for the country.

To analyze these changes in detail and to determine, in so far as possible, the causes for them, three extreme dates have been chosen: 1920, 1930, and 1933. From Chart I above it will be seen that 1920 and 1930 are at the beginning and the end of the supposedly stationary decade, while 1933 marks the end of the ensuing period of rapid growth.

GEOGRAPHIC DISTRIBUTION[2]

The popularity of Postal Savings has always varied markedly in different parts of the country. By 1920, long after the Postal Savings System had passed through its trial years, there were 506,000 depositors with $157,000,000 on deposit. A detailed examination of Table II shows that at that time Postal Savings was used most, proportionately to the population, in the industrial northeast and the West, along the two seaboards. The states using Postal Savings the least in proportion to their population were in the central and southern part of the country.

By 1930 the total number of Postal Savings depositors had changed little, but the geographic distribution of depositors had shifted considerably. A smaller proportion of the population in the seaboard states was using Postal Savings, while in the middle section of the country, the West North Central and South Atlantic States, Postal Savings had grown tremendously, relative to the number of inhabitants.

[2] In this paper the geographic divisions used by the Census are employed.

The rapid increase between 1930 and 1933 merely served to accentuate this tendency, so that by 1933 the eastern seaboard states had become among the least important users of Postal Savings facilities and Postal Savings had shifted to the West. Going from east to west, Postal Savings became of more importance in the community the further west one traveled.

TABLE II

POSTAL SAVINGS DEPOSITORS CONTRASTED WITH TOTAL POPULATION
June 30, 1920, 1930, and 1933

Geographic division	Postal savings depositors					
	Number			Number per 100 of population		
	1920	1930	1933	1920	1930	1933
New England	42,036	21,959	80,363	.57	.27	.98
Middle Atlantic	296,872	146,404	443,516	1.33	.56	1.69
East North Central	73,698	38,635	650,011	.34	.15	2.57
West North Central	20,467	70,224	357,282	.16	.53	2.69
South Atlantic	13,853	70,648	232,985	.10	.45	1.48
East South Central	6,925	7,890	63,227	.08	.08	.64
West South Central	7,098	27,680	132,574	.07	.23	1.09
Mountain	13,284	46,550	116,334	.40	1.26	3.14
Pacific	31,519	33,838	258,063	.57	.41	3.15
United States	505,752	463,828	2,334,355	.48	.38	1.90

The same general westward movement appeared in deposits, although the trend not quite so consistent, as appears from Table III.

TABLE III

POSTAL SAVINGS DEPOSITS CONTRASTED WITH BANK SAVINGS DEPOSITS
June 30, 1920, 1930, and 1933

Geographic division	Postal savings deposits					
	Amount (000 omitted)			Amount per $100 of bank savings deposits		
	1920	1930	1933	1920	1930	1933
New England	$11,079	$ 8,028	$ 53,091	$ .42	$ .17	$ 1.27
Middle Atlantic	89,332	37,351	224,893	1.90	.34	2.43
East North Central	28,027	18,866	338,198	1.01	.40	18.99
West North Central	6,848	37,413	180,019	.38	2.23	22.71
South Atlantic	3,235	25,048	96,849	.31	1.70	11.37
East South Central	1,379	1,992	33,247	.43	.38	10.71
West South Central	1,653	13,091	66,861	.53	2.56	22.85
Mountain	4,690	18,391	56,761	1.35	5.16	28.74
Pacific	10,371	14,251	134,882	.83	.65	7.96
United States	$156,614	$174,431	$1,184,801	$1.03	$ .64	$6.11

Source: Bank savings deposits—

1920—*Savings Deposits and Depositors in Banks and Trust Companies of the United States for the Years 1915, 1920, 1925, 1930;* compiled and published by the American Bankers Association.

1930—*Annual Report of the Comptroller of the Currency,* 1930, pp. 56–7.

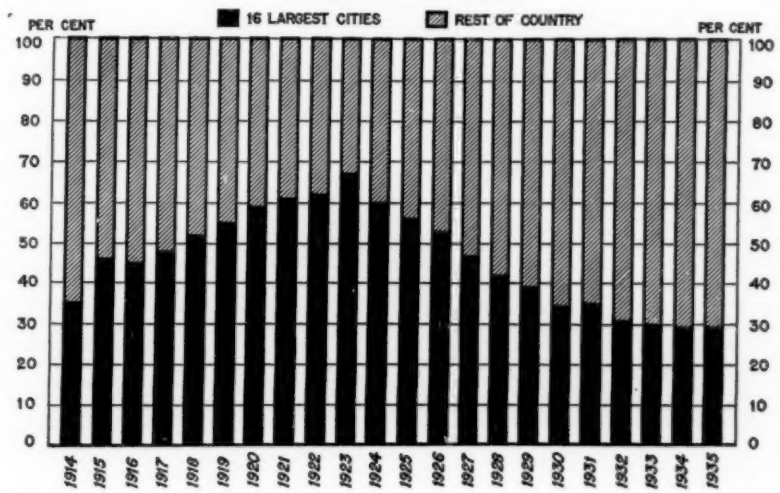
1933—*Annual Report of the Comptroller of the Currency,* 1933, pp. 99–100.

The declining importance of the industrial East is even clearer when the number of depositors and the volume of deposits in these sections in 1930 are compared with those in 1920. The New England and Middle Atlantic States had, in 1930, only 26 per cent of the deposits and 36 per cent of the depositors instead of the 64 per cent and 67 per cent, respectively, in 1920.

CHART II

POSTAL SAVINGS DEPOSITORS IN THE 16 LARGEST* CITIES COMPARED WITH THE WHOLE COUNTRY

June 30, 1914–June 30, 1935



* In 1930.

A further change in the distribution of Postal Savings during this period resulted from a shift in the relative importance of the large cities. In 1914 the proportion of all Postal Savings depositors reported by the 16 largest cities[3] was 35 per cent. This proportion increased to 67 per cent in 1923 and then declined steadily to 31 per cent in 1932 after which it remained almost constant at about 30 per cent. The trend for deposits corresponded closely.

The decline in the relative importance of the larger cities occurred in all parts of the country between 1920 and 1933 as is shown by Table IV. This trend was in spite of the general movement of population from the farms to the cities during this period.

[3] 16 largest cities in 1930: New York City, Chicago, Brooklyn, Philadelphia, Detroit, Los Angeles, Cleveland, St. Louis, Baltimore, Boston, Pittsburgh, San Francisco, Milwaukee, Buffalo, Washington and Minneapolis. These cities had an estimated total population in 1914 of 16,000,000 persons, about 1/6 of the population of the country.

TABLE IV

PERCENTAGE DISTRIBUTION OF POSTAL SAVINGS DEPOSITORS, DEPOSITS AND POPULATION BY SIZE OF COMMUNITY*
1920 and 1933

Geographic division	1920				1933			
	Per cent in towns with population† of				Per cent in towns with population‡ of			
	Under 2,500	2,500 to 25,000	25,000 to 100,000	100,000 and over	Under 2,500	2,500 to 25,000	25,000 to 100,000	100,000 and over
Depositors								
New England	11	19	16	54	6	13	17	64
Middle Atlantic	4	7	4	85	6	12	9	73
East North Central	5	16	10	69	6	22	16	56
West North Central	7	18	9	66	22	39	12	27
South Atlantic	7	15	34	44	13	34	25	28
East South Central	22	20	6	52	13	36	11	40
West South Central	12	25	16	47	17	47	12	24
Mountain	25	34	26	15	26	48	16	10
Pacific	10	21	16	53	10	26	15	49
Depositors								
United States	6	12	9	73	11	27	15	47
Deposits								
United States	6	14	9	71	10	26	15	49
Population								
United States	49	15	10	26	44	16	10	30

* Deposits and depositors are distributed by size of town in which Postal Savings depository is located. A Post Office may draw depositors from a larger community than the town in which it is located.

† Census of 1920. ‡ Census of 1930.

FACTORS IN THE CHANGES IN GEOGRAPHIC DISTRIBUTION

The principal reason for the concentration of depositors in the extreme East and West and in the larger cities in 1920 lies in the distribution at that time of the depositors by nationality. In 1915, 59 per cent of the depositors were foreign-born. They had $49,000,000, or 72 per cent of all deposits. Hence, with the foreign-born using Postal Savings to the greatest extent, it followed that those parts of the country having the largest foreign population would supply the largest proportionate number of depositors. Likewise, the preponderance of Postal Savings in the larger cities is explained by the fact that out of a total of 14,000,000 foreign-born residents in 1920, 9,000,000 lived in cities of over a 100,000 population and only 3,000,000 were in rural sections. The popularity of Postal Savings among the foreign-born was not surprising in view of the fact that a prime reason for its establishment was to attract the deposits of immigrants.

There was little change in the geographic distribution of foreign-born population between 1920 and 1933. Therefore, the shift in the

relative importance of Postal Savings in the various geographic sections of the country reflected a change in the type of depositor. This is borne out by the fact that, in 1929, only 39 per cent of the depositors were foreign born as opposed to 59 per cent in 1915.

Consideration of the analysis described in this paper tends strongly to indicate that the rapid changes in Postal Savings deposits between 1930 and 1933 were but an intensification of fundamental, though hidden, changes in the type of depositors in the preceding decade. It is therefore to be expected that bank suspensions, which are generally believed to account for the remarkable growth of Postal Savings from 1930 to 1933, should be an important factor in the earlier transformation. This is especially true when it is remembered that the spectacular bank suspensions of 1930–1933 were the climax to a wave of bank failures which had been sweeping the country since 1920. From 1921 to 1929, 5,700 banks were closed, an average of 20 closed banks for every 100 banks active in 1920.

An examination of the rate of growth of Postal Savings deposits during the same decade, however, shows very little or no correlation with bank suspensions for the country as a whole if the abnormal increases of 1930 are excluded. During four of these years, when banks were suspending in considerable numbers, the deposits with the Postal Savings System actually declined and in the other years between 1921 and 1930, the growth was inconsequential. Not even allowance for the possibility of lag between the time that these banks failed and the time that their depositors resorted to Postal Savings can account for this lack of correlation as can be seen from Table V.

TABLE V

NUMBER AND DEPOSITS OF SUSPENDED BANKS AND ANNUAL INCREASE IN POSTAL SAVINGS DEPOSITS

1921–1930

Year	Suspensions		Annual increase in Postal Savings deposits (000,000 omitted)
	Number	Deposits (000,000 omitted)	
1921	505	$172	$− 5*
1922	367	93	−15*
1923	646	150	− 6*
1924	775	210	1
1925	618	168	− 1*
1926	976	260	2
1927	669	199	13
1928	499	143	5
1929	659	231	2
1930	1,352	853	22

* Decrease from previous year.

Source: Bank suspensions—*Annual Report of the Board of Governors of the Federal Reserve System*, 1935, p. 176.

The reason for this apparent lack of relationship lies in the distribution of bank suspensions. Suspensions were not only more numerous in the western part of the country but became severe there at an earlier date. In each of the early years of the decade at least two-thirds of the bank suspensions were concentrated in three geographic divisions alone, West North Central, West South Central, and Mountain States. Other states, particularly those in the East, were at first relatively unaffected by bank suspensions. In order, therefore, to compare the rise in the number of bank suspensions with the increase in Postal Savings, the various sections of the country must be analyzed separately.

TABLE VI
RATE OF BANK SUSPENSIONS AND RATE OF INCREASE IN POSTAL SAVINGS DEPOSITS
1921–1930

Geographic division	Number of bank suspensions, 1921–1930, per 100 active banks June 30, 1920	Deposits of suspended banks, 1921–1930, per $100 of deposits in active banks June 30, 1920	Increase in Postal Savings deposits, 1921–1930, per $100 on deposit June 30, 1930
New England	4	2	−28*
Middle Atlantic	4	2	−58*
East North Central	14	4	−33*
West North Central	34	17	446
South Atlantic	38	18	674
East South Central	19	17	44
West South Central	27	13	692
Mountain	36	17	292
Pacific	10	3	37
United States	24	7	11

* Decrease in Postal Savings deposits from 1921 to 1930.

Such a comparison shows that where bank failures between 1921 and 1930 were relatively unimportant (New England, Middle Atlantic and East North Central States) Postal Savings steadily declined during those years. The relatively large proportion of Postal Savings held in these three geographic divisions was, however, so great as to conceal the changes in the opposite direction taking place in the rest of the country. It was in 1930–1933 when the widespread bank failures aroused general fear for the safety of the banks that even these sections, where Postal Savings had previously been unaffected by bank suspensions, began to register a marked growth in Postal Savings.

In Table VI the total changes between 1921 and 1930 are given. It will be noticed that the number and deposits of banks suspended have been related to the number and deposits of active banks at the beginning of the period so as to give the relative importance of the suspen-

sions in each section. The same adjustment has been made for the growth in the volume of Postal Savings deposits.

Similarly the growing importance of Postal Savings deposits in rural communities from 1920 to 1933 may be directly traced to bank suspensions. Out of a total of 11,000 bank suspensions from 1921–1932, three-fourths were in these small communities.[4] An examination of the population distribution in the United States shows that the geographic divisions which are predominantly rural were those sections which registered an increase in Postal Savings during the so-called dormant period 1920–1930, when the country as a whole showed no growth in Postal Savings. The sole exception is in the case of the Pacific States.

CONCLUSIONS

The Postal Savings System has passed through two distinct phases and is now about to start upon its third phase. Originally established for the purpose of attracting the savings of immigrants and of hoarders who did not trust American banking institutions, the Postal Savings System was useful in keeping money from being either sent abroad or secreted at home. This was borne out by the analysis of the depositors during the first decade of Postal Savings activity when it was found that the majority of the depositors were foreign born and were residents of the large industrial cities along the seaboards. The smallness of the average account seemed also to indicate that the poorer classes were using the Postal Savings depositories. Since the deposits received at the Post Office was money which otherwise would not have reached the banks, the Postal Savings System performed a valuable function and was supplemental and not competitive to the banks.

Shortly after 1920, a definite shift in the type of depositor began to appear and native-born Americans from the rural sections of the country were attracted to the System in ever growing numbers. This shift was found to be a direct result of the growth in the number of bank failures. Since the earlier bank failures were predominantly in the rural sections, the concomitant growth of Postal Savings was in these sections. At the same time Postal Savings deposits in the large cities declined so that on balance the total holdings of the System remained relatively stationary during the decade 1920–1930. It was not until 1930, when the large city banks began to fail in such large numbers as to engender fear for the safety of the whole banking system, that there was a country-wide correlation between bank suspensions and Postal Savings deposits. Nevertheless, the detailed analysis of

[4] *Annual Report of the Federal Reserve Board*, 1934, p. 167.

Postal Savings deposits has shown that the second phase of Postal Savings began as early as 1920 and, in the course of the thirteen years, 1920–1933, Postal Savings served as a haven for frightened bank depositors. During this period the Postal Savings System had changed from a supplement to the banking system to a direct competitor, although a competitor which was clearly filling a public need. Inasmuch, however, as the Postal Savings law was enacted as a substitute for the government guaranty of bank deposits, popularly demanded in 1911, this service rendered by the System during periods when the confidence in the banks was lost, may well be considered legitimate.

The reorganization of the banking system which occurred after the banking holiday of 1933, marks the beginning of the third phase of the Postal Savings System. The immigrants of the early days, for whom Postal Savings was primarily intended, have diminished in numbers and to a great extent have become acclimated to American institutions. The bank depositors who questioned the safety of the banks, and who therefore used the Postal Savings System during the second period of its life, have had their fears allayed by the establishment of the guaranty of bank deposits. At the present time the Postal Savings System appears to have no clear-cut function with regard to either of these groups. This is substantiated by the abrupt cessation in the growth of Postal Savings deposits upon the rehabilitation of the banks in 1933. Since that time Postal Savings deposits have increased relatively slowly.

From the point of view of the public the Postal Savings System today appears to render unique service in only two situations. Those communities having either no bank or no insured bank still have need of a guaranteed savings depository. On October 1, 1934, one-third of the towns and cities with Post Offices receiving Postal Savings did not have a single insured bank. Inhabitants of these communities are furnished through their local Post Office, a service comparable to that of the insured savings depositories in the banks of other communities.

For other depositors the Postal Saving System would no longer appear to be rendering any clear service. It would seem, therefore, that the Postal Savings System as now constituted has fulfilled its function. If its present trend continues, it will apparently compete with the banks over a considerable period of time without rendering any general compensatory service. Serious consideration should, therefore, be given at this time to determining what its function should be and accordingly what modifications should be made in the type of service it is to render.

THE NEW SYSTEM OF POPULATION ACCOUNTING IN THE NETHERLANDS

By Dr. H. W. Methorst
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Population registration, a valuable basis for good population statistics and consequently one of the important aids for the solution of the manifold population problems, increasingly commands the attention of all civilized countries. In most countries of the world two factors of population registration have had to suffice: (1) A census every 5 or 10 years. (2) Civil registers in which demographical facts are registered in chronological order. A third phase of population registration, and one of great importance, is a record by residence and family connection (rather than by month or year of occurrence) of data concerning birth, death and marriages, and migration.

This third factor of population registration, called "population registers," exists only in a few countries of the world. Population registers have been maintained in Belgium since 1847, in the Netherlands since 1850, in Italy since 1871, and in Denmark since 1924.[1] In Austria the Government introduced a similar registration in 1935, while in Turkey it is intended to introduce it in 1937.

Now two drawbacks are attached to the old registration system: First, when a family or a member of the family moves to another commune, the data concerning this family or concerning this member of the family, if he moves alone, are copied on a removal form and in the new commune the data are copied again from this removal form to the population register of the new commune. This gives rise to a great number of copying mistakes.

Second, under the old system, at a removal from one commune to another, only those data are transferred which represent the state of affairs at the moment of removal. Suppose a family consists of a father, mother and six children. If the mother and two children should die and later the father and children should leave the commune, it is only recorded on the removal form that a family removed, consisting of a father and four children. Consequently at every removal the demographic history of the family is broken off and begun anew from

[1] In Sweden and Finland there are Church-registers which are maintained by the clergy and which to a certain extent are analogous to our population registers.

the moment of settling in the new commune. To know the antecedents of the family, it is necessary to correspond about them with all the communes in which the family has lived from the beginning.

In the Netherlands by virtue of a Royal Decree a new system has been prescribed from July 1, 1936 on, which has already been introduced in more than 175 communes with more than one and a half million inhabitants in all, and which gradually will be adopted by all the communes. By this new system all the existing drawbacks are entirely obviated.

In the new system a card is drawn up for each child that is born. On this card is recorded the child's descent; and on it at an eventual marriage may also be recorded the name of the husband (or wife), the children born of the marriage and the children who have died. All the cards are uniform and consequently can be used for a new born child, as well as for a person 80 years old, who has been married three times and has had 12 children and a number of stepchildren. So on every card there is accommodation for the recording of the family connection, which is registered *only* on the card of the head of the family.

When one member of the family removes, the card of that person, the authentic card which was drawn up at his birth and on which in course of time his demographic history is recorded, is sent to the commune to which this person moves and inserted in the population register. In the commune of departure the data representing the state of affairs at the moment of departure, are transferred to a file card. At the removal of all the members of a family the same procedure is followed for all the cards pertaining to that family.

The new system is organized in such a way that for every person there may and can be only one card. At the removal to a foreign country, the cards relating to these persons are sent to a central office, the Inspectorate of the Population Registers. A person coming from abroad can only be enrolled after inquiries have been made as to whether a card relating to that person has been in existence. A link-register, which has a special function in the organization, enables the Inspection to see to it that there cannot possibly be two cards for one person. Inhabitants of caravans and of ships, and vagabonds, as far as they have no fixed residence, are also entered on individual cards. This special card index is maintained for the whole country by the Inspection of the Population Registers. When a person dies, his card is sent to the Central Bureau of Statistics. As the cause of death is also recorded on the card, the data thus obtained provide the basis for very valuable demographic researches.

Persons who stay in the Netherlands temporarily or those who, in

virtue of international law or usage, can claim the right of extraterritoriality are not entered in the population register. A temporary stay is considered to be a stay of not more than 30 days during the period of 90 successive days following the point of time of arrival in the Netherlands, if it concerns a Dutch subject; or a stay of not more than 180 days during the period of 360 successive days following the point of time of arrival in the Netherlands, if it concerns a foreigner. Temporary residents are not entered in the population register, but in a "temporary abode register"; they are not considered to belong to the population of the commune.

These are in brief the main principles of the new system. It implies all kinds of important consequences, which have been minutely regulated in a new Royal Decree. It came into operation in the Netherlands on July 1, 1936. Since 1930 the system has been successfully tried in a number of communes of divergent types.

In practice it has been proved that a card $17 \times 23\frac{1}{2}$ cm ($6\frac{3}{4} \times 9\frac{1}{4}$ inches) is sufficient to contain the most valuable data, which may be filled in by means of a typewriter of normal width, and that the card, which is not larger than the opening of a letter-box, may be of thin cardboard, provided it be made of excellent material, so-called "linen ledger," so that the cards may be preserved for hundreds of years.

The following important data are recorded on the individual card:

1. Christian names, and surname, day, month and year of birth, according to the birth certificate.
2. Name of commune of birth; if the commune of birth is outside the Netherlands, the name of the country.
3. Nationality.
4. Denomination or religious society.
5. Profession.
6. Christian names, day, month and year of birth and commune of birth of the father.
7. Surname, Christian names, day, month and year of birth and commune of birth of the mother.
8. Christian names, surname, day, month and year of birth, and commune of birth of the husband or wife.
9. Date on which and commune in which marriage was solemnized.
10. Date on which and commune in which marriage was dissolved, and cause of the dissolution of marriage (death, divorce, etc.).
11. Domicile and address. (At removal within the commune all the addresses are successively recorded with date of removal.)
12. The name of the new commune to which removed, recorded with the date of departure.
13. If the person comes from abroad, record is made of the last place of abode in the foreign country and the date of settling in the Netherlands.

14. Record of recognition, legitimation, denial of paternity, change of surname, or Christian names.
15. Data with regard to each of the children and stepchildren, recorded on the individual card of the head of the family: Christian names, surname, date of birth, commune of birth and whether the child is absent, married or has died; all this with mention of date. When the child has removed elsewhere or died elsewhere, the name of that commune is also recorded. At the marriage of a child it is recorded to whom he or she is married.
16. Head of the family on whose individual card this member of the family is recorded, on the card of each member of a family except the head.
17. Record of death: commune and date of death, number of death certificate and name of doctor who signed the certificate of death or who performed the post-mortem examination, and the cause of death.

The filling in of the data on the individual card is done by means of a typewriter.

A special space is left on the card for optional annotations (concerning suffrage, compulsory military service, passports, pauperism, vaccination, etc., etc.), or anything that might be considered (of value) desirable by the municipality. Some of these annotations may be made in pencil to be erased later.

Besides the above-mentioned annotations which are exclusively necessary for administrative purposes, scientific data may be recorded also, either on the card itself or on a supplementary card, concerning, for example, education received, examinations passed, special talent for art, science, politics, technical science, etc.; physical disabilities, idiocy, lunacy, abuse of alcoholic drink, hereditary diseases, feeding during the first year of life, etc., etc. To avoid misunderstanding it may be positively stated that the collecting of the last-mentioned scientific data is not prescribed. Attempts will be made to collect these data for each person individually by various means. These data may be conjoined with the obligatory data on the individual card thereby making possible important scientific researches, since the descent is recorded on each card.[2]

[2] See my paper, "Die Volksregistrierung und das neue in den Niederlanden eingeführte einheitliche System," in *Allgemeines Statistisches Archiv*, Band 26, p. 59–84.

NOTES

A TEST FOR THE GOODNESS OF FIT OF A CURVE GRADUATED TO A SERIES OF OBSERVED MEANS

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A series of means of an observed variable y has been calculated, each mean corresponding to a definite value of a variable x, the latter being considered as determined precisely. For instance, the average calories per square meter (y) of numerous individuals has been determined for successive years (x) of life. A curve has been fitted representing $\bar{y}=f(x)$ in which $\bar{y}$ is the mean of y at x. We are not here concerned with the method that has been used for fitting the curve. We assume that methods considered to be the most appropriate for the situation in hand have been utilized. The fitting may have been accomplished by use of such a criterion as least squares, or the curve may have been drawn "by eye," guided by certain *a priori* conceptions of the relationship of y and x. Is the fit a "good" fit? Intuitively, we say that if the points representing the mean values of y are very distant from the curve, all along its route, the curve is not good, for it fails to follow the points observed. On the other hand, if the observed points are always on the curve, that is, if the curve has been drawn exactly through them, the curve is not satisfactory; the entire purpose of smoothing has been forfeited. In certain regions between these extremes the curve may be considered an acceptable fit. The test described below gives a criterion for judging whether, considering the curve as a whole, it has been placed excessively far from the points, and also whether it has been drawn to accord with them too closely.

Having fitted the curve, we consider that for the purposes in hand it represents the true positions of the means. We question whether the observed means vary about the curve, as they would about the true curve, taking due regard of random variation, or whether they are improbably discrepant. In order to answer this question we make the hypothesis that the fitted curve gives the true positions of the means, and test the deviations accordingly. If the observed means are distributed about the smoothed curve as random samples from a set of true values represented by the curve, the distribution of the ratios

of the deviations of the observed means from the curve, to the standard deviations of the respective means, should be normal, i.e., Gaussian. This will be very closely true even if the original distributions of y are not normal. We therefore obtain the difference D between each mean as determined from the observations of y at x, and the value of $\bar{y}$ given by the curve at x. This is to be expressed in ratio to the standard deviation of the mean, σ_m, which will be given by $\sigma/\sqrt{n}$, where σ is the standard deviation of the values of y at x, and n the number of observations used in calculating the mean. For σ we use the best estimate available in the circumstances. If values of σ can be obtained from independent experiments, or from an independent estimate of the regression of σ on x, these values should be used.[1] But generally this will not be the case and σ is calculated by the usual formula $\sqrt{\Sigma d^2/(n-1)}$, in which d represents a deviation of y from the observed mean, and n the number of observations used in calculating the mean. While, theoretically, we should use the true value of σ, the calculations in any practical application will not be importantly affected by the use of the usual estimate of σ, if n is not small (15 or more). If n is small at particular values of x, it is desirable to group the individual observations corresponding to several consecutive values of x to estimate σ.

For the distribution of the ratios, D/σ_m, the expected value of the mean is zero, and the expected value of the standard deviation is unity. This provides a comprehensive test of the goodness of fit of the smoothed curve. If the observed means are poorly balanced above and below the smoothed curve, the mean of the ratios will differ significantly from zero, either positively or negatively. If the curve does not follow the means sufficiently closely, that is, if the means are scattered more widely about the curve than should be expected as a matter of chance, the standard deviation of the distribution will be significantly *greater* than unity. If the curve follows the means *too* closely, that is if the curve has not been smoothed sufficiently and has been drawn to follow the points very rigidly,[2] the standard deviation will be significantly *less* than unity. Thus each of these departures from a good fit can be tested specifically by obtaining the difference of the mean and standard deviation of the ratios D/σ_m and their expected values, and noting whether these differences are significant. As a criterion of a significant difference from expected values, the usual criterion of twice the standard deviation of the pertinent difference is used, or the

[1] See reference for example.

[2] If the curve is expressed algebraically, this describes the situation where too many constants have been employed in the function representing the curve.

ratio of the difference to its standard deviation may be translated to a probability by use of a table of the probability integral of the normal curve, and any desired limiting value of P may be used as a criterion for rejection. The standard deviation of the difference from the expected value of zero for the mean of the ratios is $1/\sqrt{N}$, where N is the number of points fitted; the standard deviation of the difference from the expected value of unity for the standard deviation of the ratios is $1/\sqrt{2N}$.

The special advantages of this test are: (1) its simplicity of application, (2) its applicability to curves fitted algebraically or otherwise, and (3) the fact that it furnishes a specific criterion for rejection of a curve when it fits too well. The last is exceptional. A perusal of the literature on tests of goodness of fit will divulge that the discussion of the criteria for rejection when the fit is disparate from observation is voluminous and meticulous. Discussion of the meaning to be attached to the situation in which an exceedingly close agreement is found, so close as to be suspicious, is difficult to find. At best one discovers statements as to what such a result does *not* mean, and advice as to what should be done in this instance is either not given or is ambiguous.

An application to the problem of fitting curves for physiologic standards is to be found in the following reference:

Boothby, W. M., Berkson, Joseph, and Dunn, H. L., "Studies of the Energy of Metabolism of Normal Individuals: A Standard for Basal Metabolism with a Nomogram for Clinical Application," *Amer. Jour. Physiol.*, 116, 468–484, (July 1) 1936.

THE INDEX NUMBERS, A.M.$_{I}$ AND A.M.$_{II}$*

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The relationships of price index numbers computed with the four systems of value weighting,

I. P_0Q_0, base year price×base year quantity
II. P_0Q_1, base year price×given year quantity
III. P_1Q_0, given year price×base year quantity
IV. P_1Q_1, given year price×given year quantity,

have been discussed in various places.[1] Fixed relationships have been demonstrated for indexes with certain weights. Where no fixed relationships have been found, it has usually been suggested that correlation between prices and quantities will send an index calculated with one system of weights above another with a different set of weights. This note is written to clarify to some degree the relationship between the first and second weighting systems.

If the relative price and the relative quantity movements are negatively correlated, and at the same time there is not a great spread in the sums spent upon the various commodities in the base year (i.e., not a great spread in the P_0Q_0's) then an index constructed by the use of the arithmetic mean with the first system of weights will exceed an index of the same type with the second system of weights. Under the same conditions, because of the relation between the arithmetic mean and aggregate types of indexes, the aggregate weighted with base year quantities will exceed the aggregate weighted with given year quantities. On the other hand, if the relative price and the relative quantity movements are positively correlated and at the same time the spread in the P_0Q_0's is not large, then A.M.$_{II}$ (or Ag. IV) will exceed A.M.$_{I}$ (or Ag. I). A proof of the above relationships with more exact statements follows:

$$\text{A.M.}_{I} - \text{A.M.}_{II} = \frac{\Sigma(P_1/P_0)P_0Q_0}{\Sigma P_0Q_0} - \frac{\Sigma(P_1/P_0)P_0Q_1}{\Sigma P_0Q_1}$$

* The writer wishes to acknowledge his indebtedness to Professor Francis D. Murnaghan of The Johns Hopkins University for the assistance which he has given in working out the relationships discussed in this article.

[1] Irving Fisher, *The Making of Index Numbers* (Boston, 1922), ch. v; W. V. Lovitt, "Index Number Bias," This Journal, Vol. 23 (1928), pp. 10 ff.; Warren M. Persons, *The Construction of Index Numbers*, (Cambridge, 1928), pp. 10 ff.

which—letting $x = P_1/P_0$, and $y = Q_1/Q_0$—becomes

$$\Sigma P_0Q_0x/\Sigma P_0Q_0 - \Sigma P_0Q_0xy/\Sigma P_0Q_0y .$$

Therefore the difference has the sign of

$$\{\Sigma P_0Q_0x\}\{\Sigma P_0Q_0y\} - \{\Sigma P_0Q_0\}\{\Sigma P_0Q_0xy\} .$$

Let a and b denote, respectively, the least and the greatest values of P_0Q_0. Then A.M.$_{\text{I}}$–A.M.$_{\text{II}}$ will be positive if $a^2(\Sigma x)(\Sigma y) - nb^2\Sigma xy$ is positive, i.e., letting $\bar{x} = \Sigma x/n$ and $\bar{y} = \Sigma y/n$, if $(a^2/b^2)\bar{x}\bar{y} - \Sigma xy/n$ is positive, or if $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y}$ is negative. It is to be noted that the last expression tends to become negative as a/b approaches unity, which is when the dispersion in the P_0Q_0's is not large.

The expression which determines the Pearsonian coefficient of correlation is similar to that above as r has the sign of

$$\begin{aligned}\Sigma(x - \bar{x})(y - \bar{y}) &= \Sigma xy - n\bar{x}\bar{y} \\ &= \Sigma xy/n - \bar{x}\bar{y} .\end{aligned}$$

This quantity is smaller than $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y}$. Consequently, if the latter is negative, the correlation between the price and quantity relatives must be negative. Put differently, when the correlation between the price and quantity relatives is negative and the spread in the P_0Q_0's is not great (i.e., when it is so small as to leave $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y}$ negative) it can be guaranteed that A.M.$_{\text{I}}$ will exceed A.M.$_{\text{II}}$.

In a similar fashion it can be shown that when $\Sigma xy/n - (b^2/a^2)\bar{x}\bar{y}$ is positive, r is positive and A.M.$_{\text{II}}$ > A.M.$_{\text{I}}$.

Several simple illustrations may be added to the above.

Commodity	Base Year		Given Year			
	Price	Quantity	Price	Price Relative	Quantity	Quantity Relative
A	3	2.5	6	200	2.5	100
B	4	2	2	50	6	300
				A.M. = 125		A.M. = 200

In this hypothetical case, r for the price and quantity relatives has the sign of $\Sigma xy/n - \bar{x}\bar{y} = -.75$; while $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y} = -.45$. It can be guaranteed that A.M.$_{\text{I}}$ > A.M.$_{\text{II}}$, which if worked out are respectively 123 and 86. It should be noted that the spread in the P_0Q_0's is small, for commodity A, $P_0Q_0 = 7.5$; for B, 8.

In the following illustration, also, A.M.$_{\text{I}}$ > A.M.$_{\text{II}}$, but the spread between a and b is such that the relationship between the two indexes could not be guaranteed.

Commodity	Base Year		Given Year			
	Price	Quantity	Price	Price Relative	Quantity	Quantity Relative
A	1	1	2	200	2	200
B	4	2	2	50	6	300
				A.M. = 125		A.M. = 250

In this example, r for the price and quantity relatives has the sign of $\Sigma xy/n - \bar{x}\bar{y} = -.375$; but $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y} = +2.70$. The spread in the P_0Q_0's is large here, for commodity A, P_0Q_0 equals 1; for B, 8. A.M.$_{\text{I}}$, however, exceeds A.M.$_{\text{II}}$; the former is 67, the latter 62.

THE ANALYSIS OF REGRESSION IN SUBSETS OF VARIABLES

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My paper, "A Simplified Method of Determining Multiple Regression Constants," which was published in a recent issue[1] of this Journal, outlined a method of calculating all the usual measures of regression and correlation and their standard errors in a set of n variables. If that method is used to analyze a problem of n variables it is easy to derive measures of regression and correlation in any or all subsets of $n-1$, $n-2$, etc., variables. This is very important since a study of relationships among the n variables will often indicate the desirability of dropping one or more variables and using as the most reliable measure of the influence of each independent variable on the dependent the regression in some subset.

The previous paper gave a method of deriving the reciprocal correlation matrix, each element of which is

$$P_{ij} = R_{ij}/R \tag{1}$$

where R_{ij} is the cofactor of r_{ij} in the zero-order correlation matrix and where R is the determinant value of that matrix. The necessary statistical measures of relationship in a set of n variables can be derived easily from the P_{ij} values. It is also possible to derive a somewhat similar P matrix in the subset leaving out the variable x_k. If we denote an element in such a matrix by $P_{ij)k(}=R_{ij)k(}/R$ these elements may be calculated from the P_{ij} values by the equation

$$P_{ij)k(} = P_{ij}P_{kk} - P_{ik}P_{jk}\,. \tag{2}$$

For example, let us suppose the P_{ij} matrix has been calculated in a problem of eight variables. We wish to drop the variable x_5 and derive the values of $P_{ij)5(}$. Equation (2) shows that $P_{11)5(}=P_{11}P_{55}-P^2_{15}$; that $P_{12)5(}=P_{12}P_{55}-P_{15}P_{25}$; etc.

These $P_{ij)k(}$ values can be used in place of the corresponding P_{ij} in equations (5), (6), (7) and (8) of my previous paper to get the necessary statistical measures in the remaining set of variables after x_k has been eliminated.

The i'th line of the $P_{ij)k(}$ matrix can be checked by

[1] Vol. 30 (1935), pp. 694–700.

$$\sum_j P_{ij)k(} r_{ij} = P_{kk} . \tag{3}$$

Similarly the elements $P_{ij)kl(} = R_{ij)kl(} P_{kk}/R$ in the set leaving out variables x_k and x_l can be derived by

$$P_{ij)kl(} = P_{ij)k(} P_{lj)k(} - P_{ij)k(} P_{jj)k(} . \tag{4}$$

The check on the i'th line of the $P_{ij)kl(}$ matrix is

$$\sum_j P_{ij)kl(} = P_{kk} P_{lj)k(} . \tag{5}$$

By an extension of the same process it is possible to drop one variable at a time until we have the necessary relationships in any subsets we wish to study. Whether it is necessary to drop only a few variables or to study all subsets of all orders the writer believes the method outlined above is simpler and requires less work than the method outlined by Frisch[2] and certainly requires much less work than would be required for separate solutions for each subset.

Equation (2) is derived from Sylvester's theorem concerning the minors formed from cofactors. According to that theorem

$$R_{ij} R_{kk} - R_{ik} R_{jk} = R R_{ij)k(} . \tag{6}$$

Substituting in (6) $R_{ij} = R P_{ij}$

$$R^2 (P_{ij} P_{kk} - P_{ik} P_{jk}) = R R_{ij)k}$$

or, dividing by R^2

$$P_{ij} P_{kk} - P_{ik} P_{jk} = R_{ij)k(}/R . \tag{7}$$

Equation (4) is obtained by a similar development. The same general process can be used to drop any number of variables one at a time and to derive for any subset the cofactors of r_{ij} multiplied by a constant which does not in any way affect their use in calculating measures of regression and correlation.

[2] Ragnar Frisch, *Statistical Confluence Analysis by Means of Complete Regression Systems*, Universitetets Økonomiske Institutt, Oslo, Norway, 1934.

A TREND LINE FOR GROWTH SERIES, FURTHER REMARKS

A year ago this JOURNAL[1] carried a brief presentation of "A Trend Line for Growth Series," being tried by the Research Section of the Federal Reserve Bank of New York.

$$y = bc^{1/(d+x)}$$

$$\log y = \log b + \log c/(d + x).$$

This line, or curve, combines the useful characteristics of rising at a constantly decreasing percentage rate, and approaching an asymptote instead of, at some stage, turning down. These general characteristics can be obtained in other curves, but not so easily and simply.

The constants, b, c, and d, may be obtained by the successive solution of the following equations (setting the year of the first fitted point, X_1, equal to 0):

$$d = \frac{X_2X_3(\log y_3 - \log y_2)}{X_3(\log y_2 - \log y_1) - X_2(\log y_3 - \log y_1)}$$

$$\log b = \log y_2 + d(\log y_2 - \log y_1)/X_2$$

$$\log c = -d(\log b - \log y_1).$$

Those who have experimented with the curve may be interested in a method by which, given the three points to be fitted, the three constants may be calculated with even greater ease and speed than is otherwise possible.

There is a first saving in time by spacing the three fitted points equally (i.e., making $X_2 - X_1 = X_3 - X_2$), and giving the value -1 to X_1, 0 to X_2, and $+1$ to X_3. Thus taking 1890 (the first fitted point) $= -1$, 1910 $= 0$, and 1930 $= +1$: 1891 will be $-.95$; 1892, $-.90$; 1893, $-.85$; . . . ; 1911, .05; . . . ; 1929, .95. There is a further saving in time by expressing the ordinates of the three fitted points, y_1, y_2, and y_3, as ratios to the ordinate of the first fitted point. This conveniently makes the logarithm of the first ordinate equal to zero.

The constants of the equation for the curve can then be derived from the following equations:

$$d = \log y_3'/(2 \log y_2' - \log y_3')$$

$$\log b' = d \log y_2'$$

$$\log c = -(d - 1) \log b'$$

$$\log b = \log b' + \log y_1$$

where $\log y_2' = \log y_2 - \log y_1$ and $\log y_3' = \log y_3 - \log y_1$.

NORRIS O. JOHNSON

[1] Vol. 30 (1935), p. 717

THE PURPOSE AND PROGRESS OF THE ATTORNEY GENERAL'S SURVEY OF RELEASE PROCEDURES

On January 7, 1936, Attorney General Homer S. Cummings announced a nation-wide survey of parole, probation and all other forms of release granted by courts and penal institutions to persons found guilty of crime. This survey constitutes an integral part of a program for adequate and effective crime control and prevention through widespread public education, a careful evaluation of the effectiveness of various release practices now in use, the development of standards for adequate equipment and personnel and the consolidation of the efforts of those interested in the prevention of crime throughout the country. Its inception is a response to the recently aroused public sentiment against parole.

In initiating this survey, the Attorney General wrote personally to the Governors and Attorneys General of all the states, describing in broad outline the objectives of the survey and requesting their cooperation. The replies from the Governors and the Attorneys General were most favorable —in fact, enthusiastic. The policies of the survey were drawn up by an executive committee consisting of Mr. Justin Miller, Chairman of the Attorney General's Advisory Committee on Crime and Administrative Director of the Survey of Release Procedures; Mr. Brien McMahon, Assistant Attorney General in charge of the Criminal Division of the Federal Department of Justice; and Mr. Sanford Bates, Director of the Federal Bureau of Prisons. The preliminary plans of the survey, especially of its technical phases, were submitted to members of the American Sociological, Statistical, and Prison Associations in New York City on December 29, 1935, for advice and criticism.

The survey has two aspects. One is qualitative in character, dealing with a first-hand study of the facilities available for courts, probation departments, penal and correctional institutions and parole departments. The other phase is statistical in nature, dealing with case history material of individual inmates, parolees and probationers.

The field work began in mid-January, 1936, after a period of intensive training of eleven regional directors and eleven regional field supervisors. The regional field supervisors also had an extensive training period of several months in abstracting information from Federal files in Washington prior to their assignment in the field. The regional directors were sent out to make the contacts in the states and to obtain first-hand information about court and institutional facilities in the disposition and treatment of persons found guilty of crime. The regional field supervisors were sent out to set up WPA work units in institutions and courts for the abstraction of official statistics on carefully prepared case history schedules. These forms are recorded and verified in the field and then sent to Washington where they are submitted to a rigid consistency check. All case history schedules which do not with-

stand this test are sent back to the field for necessary corrections and verifications. When the schedules have been satisfactorily completed, they are coded and the data transferred to punch cards for mechanical sorting and tabulation.

Subsequently the data are analyzed to determine:

(a) the frequency of various types of releases by different courts, penal and correctional institutions and parole authorities;
(b) the interrelation between the various personal, social and other characteristics of persons found guilty of crime in relation to the dispositions made of their cases;
(c) in cases of persons placed on probation or parole or other forms of provisional release, the interrelation that may exist between various characteristics of these persons and the likelihood that they will complete their provisional release periods successfully;
(d) the criteria used by various courts, penal and correctional institutions and parole authorities in the selection of persons for various forms of release;
(e) whether the available case history data obtained by custodial institutions, probation and parole authorities can be systematized to aid judges, probation officers and pardon and parole boards in selecting persons for different forms of release; and
(f) the extent to which the available case history material can be systematized for the use of probation and parole officers in the individualization of their methods of supervision for more effective results.

To insure the uniformity and comparability of data collected from various jurisdictions, each recorder and each verifier is supplied with detailed instructions which are uniform throughout the country. There are standard schedules and instructions prepared for the regional directors in their qualitative phase of the work, also with the object of securing uniformity of approach throughout the country. To date, the regional directors, besides making personal contacts in their respective areas, have completed an intensive survey of the statutes and laws of different states which concern the sentencing and releasing of persons found guilty of crime. Rapid progress is being made in filling out questionnaires which embody a comprehensive analysis of the facilities and practices of the courts of general criminal jurisdiction in various parts of the country. Questionnaires designed to provide a comprehensive inventory of the facilities, personnel, procedures and practices of various state penal and correctional institutions are also being filled out. Similar questionnaires have been prepared to provide a detailed inventory of the facilities for probation and parole in different jurisdictions. All of these are to be filled out by the regional directors. Up to the present time, 117 work units under the immediate supervision of the regional field supervisors have been set up in the District of Columbia and 46 of the states.

These units have completed to date about 120,000 schedules of Federal and state parolees or persons whose provisional release was granted and terminated by discharge or revocation between 1928 and 1935, inclusive.

About half of these schedules have been edited and coded and the data recorded on punch cards. This material is now being subjected to intensive analysis and some preliminary analyses have already been made of the Federal cases. In so far as the analysis has proceeded, results appear to be consistent with previous knowledge and the findings in no case appear unreasonable in the light of what was expected. Similar case histories are being recorded on appropriate schedules for unconditionally released cases. Fifteen thousand of these case histories have already been recorded and are now in Washington or will shortly be shipped there. In addition to this, about 3,000 schedules have been completed on probation cases throughout the United States. This phase of the study is just beginning and will be expanded to include about 100,000 cases.

In order to determine the degree of precision with which the case history data are being abstracted from prison files, three sets of Federal schedules of 500 each were re-recorded by two separate sets of recorders, independent of one another, and the results have been analyzed to determine the consistency with which information for the different case history items can be abstracted from the files. One of these sets is being re-recorded a third time by a new group as a further basis for determining consistency. Similar controls are being used in the field. To date some 7,000 schedules in all have been duplicated by the different units to check the consistency of the work in each unit.

The survey is financed by WPA funds and has provided employment to over 750 persons. Consistent with the policy of the WPA, 90 per cent of the employees are from local relief rolls. Effort is being made to extend the work to all the states and to as many courts as possible, as rapidly as the limitations of supervisory personnel permit, without jeopardizing the uniformity of the work and the high standard of precision which is being maintained in this study.

The progress of the survey has been made possible through the hearty cooperation of state authorities who have generously aided us by placing at our disposal their files, necessary equipment and even, in some instances, supervisory personnel so as to assure the success of this nation-wide undertaking.

BARKEV S. SANDERS

Washington, D. C.
October 23, 1936

TRAINING FIELD AGENTS IN THE BUREAU OF LABOR STATISTICS

For several years the Bureau of Labor Statistics has been conscious of the fact that one of its pressing problems was to build up a staff of field agents properly and intelligently equipped to handle the complex work of the Bureau in the field of wages, hours of labor, and working conditions. These surveys are now made every two or three years in the more important industries of the country. In the less important industries they are made at irregular intervals.

In each of these surveys information is collected concerning wages and hours, annual earnings, descriptions of technological processes and individual occupations, personnel policies, and working conditions. The wages and hours data are compiled from the pay-roll records of the firms covered. Information as to occupation, race, sex, rate of pay, total earnings and total hours worked during the selected pay-roll period, and number of hours worked for one continuous week within that pay-roll period is obtained for each individual worker. The data collected on annual earnings consist of total earnings for a calendar year, as well as the total pay-roll periods worked.

Descriptions of technological processes and individual occupations are obtained by interviews with foremen and other supervisors actually in charge of the work, and by observation of the various operations involved in the shop or factory. The data concerning personnel policies are usually obtained by means of interviews with personnel or industrial managers and other persons in charge of these activities. Considerable information is also obtained from the personnel records of employees as to age, length of service, citizenship, etc.

To collect this information the Bureau has developed a trained staff of field agents. These agents are usually selected from the clerical staff of the Division of Wages, Hours, and Working Conditions, where they have acquired considrable experience in coding, editing, and tabulating. This background is helpful in properly carrying on the work in the field.

In addition to a knowledge of the statistical procedure involved, a satisfactory agent must also have an accurate understanding of the problems peculiar to the different industries studied. To meet this need, Commissioner Lubin two years ago inaugurated the practice of giving the agents a short training course in Washington prior to each field assignment. These courses last from three days to two weeks, depending on the complexity and importance of the industry. They are conducted under the supervision of the chief of the Wages and Hours Division, assisted by the section chiefs and the field supervisors in charge of the various phases of the work connected with the surveys. Lectures are also given by experts from the respective industries. Occasionally the lectures are illustrated by moving pictures of actual opera-

tion in the various plants. At these training courses the problems of sampling are also discussed and the agents are given their field instructions.

During the past summer these specialized training courses were supplemented by a general course in labor and industrial economics and statistics. The course was organized in cooperation with American University at Washington and was conducted on a college basis, credit toward a degree being accorded if desired by those completing the course satisfactorily. The course lasted three weeks, from August 3 to 22, during which period the field agents devoted full time to their classes and studies. The morning was given to lectures and discussions. The first two hours were under the auspices of Dr. Philip Taft of the University of Wisconsin, one hour being devoted by him to the subject of labor and industrial problems and the other to personnel and industrial management. The third hour was conducted by J. Perlman, chief of the Bureau's Division of Wages, Hours, and Working Conditions, who presented a survey of labor statistics as related particularly to the field of wages and hours. The afternoons were devoted principally to reading assignments. Written reports were also required daily, as well as a semester paper covering a particular topic in the course. At the completion of the course a final examination was given.

It is hoped that in the future it will be possible for the Bureau to continue these training courses for its field agents.

JACOB PERLMAN

Washington, D. C.

A COÖPERATIVE ARRANGEMENT FOR GENERAL RELIEF STATISTICS

The Social Security Board and the Works Progress Administration, each requiring comprehensive current statistics of general public relief for effective planning and administration of their programs, have entered into an arrangement which will utilize personnel and facilities of both organizations for the monthly compilation of these data. The Federal Emergency Relief Administration still requires regular statistical reporting on the part of a considerable number of state relief administrations having unexpended balances of Federal funds and is also a party to this arrangement.

A staff of professional and clerical personnel has been assigned to work under the joint auspices of the Division of Research, Statistics and Records of WPA and the Bureau of Research and Statistics, Social Security Board. This staff, under the immediate direction of Thomas B. Rhodes, formerly Assistant Director of the Division of Research, Statistics and Records, WPA, has responsibility for collection and analysis of the monthly relief statistics. Field work in connection with the current reporting is a joint responsibility of the Social Security Board and WPA, although it is expected that in most states field work will be performed by the statistical field representatives of the Board. This plan, it is hoped, will result in considerable economy in field work, as well as convenience to state departments adminis-

tering both general and categorical relief. The data will continue to be published in the FERA monthly bulletin, *Trend of Relief in Continental United States*. It is not anticipated that basic changes will be made in the scope of the data which have been reported for the purposes of the FERA.

To facilitate this joint program an Advisory Committee on Collection of General Relief Statistics has been appointed by the Social Security Board and WPA for the purpose of currently advising on problems relating to the collection, interpretation and publication of the statistics. The chairman is Ralph G. Hurlin of the Russell Sage Foundation. The other members are Paul Webbink of the Committee on Social Security, Social Science Research Council; Frederick F. Stephan, Secretary of the American Statistical Association; Ewan Clague, Associate Director, Bureau of Research and Statistics, Social Security Board; and Emerson Ross, Director, Division of Research, Statistics and Records, WPA. The first three are members of the Joint Committee on Relief Statistics of the American Public Welfare Association and the American Statistical Association. The last two serve as representatives of the two coöperating Federal agencies. Mr. Rhodes acts as secretary of the committee. A member of the staff of the Central Statistical Board participates in its activities, as does also Helen R. Jeter, Acting Chief, Division of Public Assistance Statistics, Social Security Board, and T. E. Whiting, Assistant Director, Division of Research, Statistics and Records, WPA.

A review of recent developments in relief statistics is to be published in a forthcoming issue of *The Survey*.

PROGRESS OF WORK IN THE CENSUS BUREAU

THE 1935 CENSUS OF BUSINESS

Preliminary United States Summaries covering Retail Distribution, Service Establishments, and Radio Broadcasting were released in October. Summary reports on Banking Institutions and Wholesale Trade were issued during November; and reports for Construction and Busses will be available early next year. The summary reports show, by kinds of business, the sales or receipts, active proprietors and firm members, employees, and pay rolls, for the United States and for each state.

Two studies conducted by the Bureau of the Census in connection with the census of business will be of special interest to JOURNAL readers. The first of these is an attempt to set up sampling areas which will be representative of retail trade. It has been proposed on several occasions that a national census of business be taken quinquennially and that comparable annual data be secured from a limited survey of retail and wholesale trade. The research now under way is being limited to retail trade. Attention is being given to different types of sampling techniques but most of the research at present is concerned with testing area samples. These tests will determine the feasibility of selecting a group of counties or cities, or both, from each state so as to provide a representative sample of retail sales, the economic and social factors affecting sales in each state, and in the different size classes

of cities in the country as a whole. Nearly 300 area samples have been tested with data on retail sales by the eleven-fold breakdown (Food Stores, Eating Places, etc.) of the reports for 1929 and 1933. A number of special tabulations of the 1935 census will be made for these area samples. It is hoped that area samples will provide sufficiently reliable data in measuring annual fluctuations to meet the needs for inter-census estimates comparable with the 1935 census of business, the 1933 census of American business, and the 1929 census of distribution.

The second special study pertains to individual cities. Business areas are being laid out in much the same manner as census tracts have been established for the census of population. The more important business areas of several large cities are being mapped and studied in preparation for their possible permanent use as statistical areas. This will provide the basis for studies such as the shift of certain types of business from one area to another, the growth of sub-centers, the relation between sales and population density or purchasing power, etc.

THE 1935 CENSUS OF AGRICULTURE

Volume II of the 1935 census of agriculture, containing statistics on farm population, the movement of population from cities to farms, farm labor, non-farm employment of operators, and the fruit, vegetable, legume and other items of farm produce not included in Volume I, will be available for distribution in January. This volume contains the second series State bulletins, previously issued, and a United States summary. A third volume entitled "Statistics by Subjects" is now in preparation. Though smaller than Volume IV of the 1930 census of agriculture, this report will be entirely comparable with it for all items covered in the 1935 census. These three volumes will complete the major reports of the 1935 census.

Minor civil division tabulations.—Nearly all items in Volumes I and II of the 1935 census of agriculture, except those with a cross tabulation by color and tenure, and by size of farm, have been tabulated by minor civil divisions. The publication of these data for the more than 50,000 townships and other minor civil divisions is impossible with present printing funds. However, the demand for such detailed statistics is very widespread and the Bureau of the Census, in cooperation with the Resettlement Administration and the Agricultural Adjustment Administration, is preparing transcription sheets for all states. These tables can be secured from the Bureau of the Census in the form of photostat copies of the state transcription sheets. The Bureau will be pleased to send all interested parties detailed information concerning minor civil division data.

C. L. D.

CHAPTER ACTIVITIES

THE CONNECTICUT CHAPTER.—The Connecticut Chapter met in New Haven on October 22, 1936. The speaker at this meeting was Dr. Dorothy Swaine Thomas of the Institute of Human Relations at Yale, who has just returned from Sweden where she spent six months studying internal migration. The topic for discussion was "Continuous Population Registers in Holland, Sweden and Belgium." Dr. Thomas traced briefly the historical development of population registration and the technique of registration. She emphasized the utility of registers in producing data for the study of population movements.

THE CLEVELAND CHAPTER.—The first meeting of the 1936–1937 season for the Business Statistics Section of the Cleveland Chapter was held on September 28 at the Mid-Day Club. Fourteen members and guests were present. Mrs. Frida Selbert of the National Machine Tool Builders Association was chosen as Chairman for the ensuing year and Mr. J. T. Diebold of The Ohio Bell Telephone Company was reelected to the office of Secretary. After the selection of officers, the group made its semi-annual forecast of the index of industrial production of the Board of Governors of the Federal Reserve Board. The arithmetic mean of the individual forecasts for the 12 months ending with August, 1937, was 12 per cent above the actual average for the preceding 12 months. The percentage improvement estimated by the individual members ranged from 9 per cent to 16 per cent.

THE PITTSBURGH CHAPTER.—During the summer, meetings were held on July 23 and August 27 to plan the programs for the coming year and discuss other Chapter activities. On September 24 a meeting was held on the degree of recovery and probable future activity in three major lines of business activity. Mr. G. A. Doyle of the Bell Telephone Company of Pennsylvania discussed "Communication." Mr. David Tynberg of Kaufmann's Department Store discussed "Merchandising" and Mr. B. E. V. Luty of American Metal Market discussed "Steel."

THE SAN FRANCISCO CHAPTER.—In response to an inquiry from the District Secretary several members reported significant statistical studies in the San Francisco district. Mr. Fernando E. Harrison, Statistical Supervisor of the California State Employment Service, reported the release for the first time of detailed tabulations of the active file of the State Employment Service. This file is maintained under the perpetual inventory project in cooperation with the U. S. Employment Service. Dr. Emily H. Huntington, Chairman of the Heller Committee for Research in Social Economics, reported two studies of the standard of living of families in San Francisco and the East Bay. Mr. Charles P. Burgess, Statistician of Heller, Bruce & Company, reported a tabulation of financial statistics of the fifty largest cities in California showing direct and overlapping debt, government costs, tax collec-

tions and wealth indices. Similar data were tabulated for California counties. Mr. L. J. Schmoll, Assistant Secretary of the Metropolitan Life Insurance Company, reported that San Francisco had been divided into census tracts and the census tract system had been approved by the Geographer of the Bureau of the Census.

STATISTICAL NEWS AND NOTES

BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.—A study of the growth and distribution of large deposit accounts was published in the September *Federal Reserve Bulletin*. It was based on a survey of about 9,900 identical deposit accounts at 98 large member banks in 37 cities for October 25, 1933, and November 1, 1935. The survey was undertaken to ascertain the distribution of deposits among large and small depositors and among different economic groups and the significance of changes in the distribution.

The September *Bulletin* also contained a description of new statistical material relating to the volume of credit extended by brokers to their customers, together with related items, which now appears in a regular table in the *Bulletin*.

FARM CREDIT ADMINISTRATION.—The statements of condition of the Federal land banks, Federal Farm Mortgage Corporation and Federal intermediate credit banks published quarterly by the Farm Credit Administration through December, 1935, have been replaced in 1936 by a new publication entitled the *Farm Credit Quarterly*. In addition to financial statements of lending institutions the *Quarterly* includes articles on particular phases of the agricultural credit situation, especially as related to the functioning of the Federal farm credit system. The new publication also contains appendix tables covering loans and discounts of institutions under the supervision of the Farm Credit Administration, the outstanding securities of these institutions, and indexes of farm income by Farm Credit Administration districts.

BUREAU OF AGRICULTURAL ECONOMICS.—The Bureau of Agricultural Economics is engaged in testing wheat yield data collected in connection with the Agricultural Adjustment Administration to determine their adaptability for rate making in various proposed crop insurance plans. Costs of indemnifying wheat crop losses have been determined in 210 counties. Data on identical individual farms cover the 6-year period 1930 to 1935 inclusive.

In the field of farm-mortgage credit the Bureau of Agricultural Economics in cooperation with the Bureau of the Census sent out special schedules to more than 400,000 farm owners. Nearly a 40 per cent return has been received. The data are now being tabulated and it is anticipated that with these and other data available it will be possible to issue a preliminary farm-mortgage debt estimate by states for 1935 and 1936 shortly after the first of the year.

The Division of Farm Population and Rural Life began in August a

special survey of farm labor conditions in eleven counties scattered over the country and selected as representing certain types of farming. Mr. Josiah C. Folsom, assisted by Mr. Tom Vasey, supervised the work. Field work was started in August and completed in October. It is expected that tabulations will be finished in November. Data gathered concern farm laborers' working and living conditions, wage rates, perquisites, earnings, occupational experience, education, and participation in community life.

A series of studies have recently been undertaken for the purpose of improving the technique of gathering, analyzing, and publishing market news on agricultural products. Mr. S. R. Newell of the Division of Marketing Research is in general charge of these studies, but most of them will be made in cooperation with the various commodity divisions of the Bureau. Market reporting has from the beginning been one of the principal activities of the Bureau. The new research program is designed to test the reliability of market news, its adequacy for different uses and for different groups of people, and the effectiveness of the different types of reports and different methods of dissemination. The rapid changes in marketing methods which have occurred during the past decade, such as the growth in direct buying in many lines, appears to have made significant changes in the type of market news information which is needed and also has brought with it a number of new difficulties in getting reliable information.

One of the first of these studies to be undertaken is concerned with market reports on tobacco. Intensive work is now being done in this field and is being used in setting up a new marketing service covering tobacco auctions. In this problem, as in the case of most price reporting problems, one of the principal needs is to develop a method of sampling which will give a fairly accurate indication of the average price and of the range in prices on a particular day, and which will also give a reliable indication of the change in average price from day to day and from week to week. In the case of tobacco, the reliability of different sampling methods can be tested because complete records of all auction sales are available and they are classified according to grade and according to the type of buyer.

THE FEDERAL TRADE COMMISSION.—The Federal Trade Commission has largely completed its work on the study of agricultural income and related matters directed by the Wheeler Resolution (P. Res. 61, 74th Congress, First Session). This Resolution was extended into the field of table and juice grapes and fresh fruits and vegetables by Joint Resolution known as the Gearhart Resolution (P. Res. 61, 74th Congress, Second Session). The work of setting up this inquiry which calls for substantially the same information as was asked for under the terms of the Wheeler Resolution is now under way. The same is true of the inquiry into agricultural implements also directed by the last session of Congress (P. Res. 130, 74th Congress, Second Session).

The Commission released a few weeks ago another report on milk and milk products which contains some interesting statistical data for those

who are interested in the subject of milk. This report covers two or more milk distributing companies in each of the four cities of Boston, St. Louis, Cincinnati, and Baltimore. This report and one other which preceded it on the Philadelphia and Connecticut milk sheds are important, particularly for the reason that these reports present for the first time in any publication the actual gross profits of distributors separately for fluid milk, fluid cream, and other milk. The report on these four cities also contains detailed statistics on investment and profits of leading milk distributors in these markets. Other interesting statistical data in the report include information on butter-fat differentials, costs of operating country stations, and costs of handling various items sold from milk wagons on retail delivery routes. Still another interesting tabulation in the report is the distribution of the producers selling to one St. Louis distributor according to the number of quarts of milk delivered each day.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE.—By the first of the year eight publications of major importance in both the domestic and foreign fields will have been released by the Bureau of Foreign and Domestic Commerce:

Foreign Trade of the United States for the Calendar Year 1935. A statistical and analytical summary of final figures on the total trade of the United States for 1935. Detailed statistics for 1935 and preceding years show total United States exports to and imports from the world, the geographic distribution of exports and imports, and the distribution of trade by economic classes and commodities.

Foreign Commerce and Navigation of the United States, Calendar Year 1935. An annual publication in which statistics of both exports and imports are shown in the 1935 edition. Data cover trade of the United States and its noncontiguous territories with foreign countries, trade in gold and silver, and intransit trade. The number, nationality and tonnage of vessels entered and cleared in foreign trade of the United States with each country during 1935 are also shown as well as customs districts, headquarters, and ports of entry.

Statistical Abstract of the United States, 1936. The fifty-eighth annual issue of this publication gives a summary of authoritative statistics showing the trends in trade and industry as well as social progress. It represents a digest of data collected by all statistical agencies of the National Government, as well as those of a considerable number of private agencies and several states.

Sources of Current Trade Statistics. This publication lists sources of pertinent current economic statistics released by both governmental and private agencies. This volume is designed to minimize the delay in finding sought-for data on production, shipments, employment, prices and orders by kinds of business and for products.

Foreign Commerce Yearbook, 1936. A compilation of economic statistics giving recent basic statistical information on commerce, industry and

finance, for more than sixty foreign countries with comparable data for a series of earlier years. The second part of the publication shows tables of comparative world statistics for a number of major subjects including tables of international trade accompanied by a review of that subject for 1935.

Basic Industrial Markets of the United States. This series of bulletins, which was begun with a study of the textile market last June, is designed to segregate by location (counties) and density (machinery in place and plant capacity to produce) the major industrial markets of the country. Additional reports which will be available by January include *Iron and Steel* and *Gas and Electric Utilities.*

Insurance Transactions in the Balance of International Payments of the United States, 1919–1935, released the last of August, is a study of the movement of funds into and out of the United States on account of the operations of foreign insurance companies in the United States and of United States insurance companies abroad. The text of the survey sets forth the annual movements of insurance funds, the influences affecting the flow, and the origin and destination of the funds by countries and geographic areas. Material is also presented in tabular form for a period of years.

Regional Sales of General Merchandise in Small Towns and Rural Areas. An article which appeared in the September issue of the *Survey of Current Business* in which was presented a new group of indexes together with a description of the method employed in their construction. The series represents rural retail sales of general merchandise in four main regions of the country, the East, the South, the Middle West and the Far West. Both the adjusted and unadjusted index figures are shown from January, 1929. Reprints of the article are available from the Bureau.

Store Modernization Needs. This study, released in August, is the result of a cooperative effort of the Federal Housing Administration and the Bureau of Foreign and Domestic Commerce. It presents, on the basis of a limited sample, an analysis of the actual physical condition and appearance of small and medium-sized retail stores and service establishments for 18 different kinds of business. Appropriate recommendations for improvement of such stores and certain observations pertinent to the findings are also presented.

A Manual of Small Retail Stores is in course of preparation. It will consist of about nine separately published booklets covering many phases of retailing of interest to the small operator. Several of the booklets are expected to be off the press before the end of the school year.

The series of trade association bulletins on some of the major industries of the United States, namely: *Construction, Foodstuffs,* and *Lumber and Allied Industries* will present sources of more detailed information, the names of those Government agencies most closely allied to the industry, and a list, with addresses, of national and interstate trade associations. Reprints of the *Construction* bulletin, which was the first of the series and

was released in April, are now available. *Foodstuffs Industries* and *Lumber and Allied Products* bulletins were released in November and December respectively.

The 1936 edition of *Selected Trade Associations of the United States* will be available shortly. This publication covers the nation's 2,600 trade associations of national and international scope.

BUREAU OF LABOR STATISTICS, U. S. DEPARTMENT OF LABOR.—Actual wage rates paid in the construction industry on public as well as private construction are being compiled and analyzed for 103 cities. For many years the Bureau has made annual surveys of union wage rates in the various building trades, but this is the first general survey of the wage structure existing in the building industry generally. The union wage survey for 1935 is now completed and the results will be published in the *Monthly Labor Review*, probably beginning with the December, 1936, issue.

The wage and hours survey of the shipbuilding industry that was being planned when the last issue of the JOURNAL was published is well under way. Coverage for Navy construction and repair will be 100 per cent and there will also be an adequate sampling for private yards. Out of this work it is expected that information will be made available on annual earnings as well as wages and hours, personnel policies, and occupational descriptions. Work on the bituminous coal industry study is still in the planning stage. It is proposed to use a 20 per cent sample chosen from the mines in all important producing states and from among deep and shallow workings.

Accident statistics for manufacturing and iron and steel workers in 1934 have been completed and published and it is anticipated that the 1935 returns for both groups will be completed about the end of the year. The Bureau is making plans to extend cooperation with the states, other Governmental agencies, and a number of universities for enlarging the scope of information made available in this field.

Field work on prison labor conditions has been completed in seven states, reports are available for three of these, and work is in progress in three additional states under the cooperative arrangement between the Prison Industries Reorganization Administration and the Bureau. This investigation of prison labor is more comprehensive than earlier work done in this field. Formerly statistics of the amount and value of goods made by prisoners were compiled. This is being continued but in addition the general social and economic problems connected with supplying work for prisoners under a state use plan are being inquired into.

A series of articles on union-management relations in particular industries and localities is appearing currently in the *Monthly Labor Review*. Studies of the glass industry, women's clothing manufacture in New York, and the hosiery industry have already been published and others will follow.

The 1936 edition of *Handbook of Labor Statistics* (Bulletin No. 616) is now available. This volume is the fourth of a series published by the Bureau in which labor matters during 1931–35 are reviewed and in which practically

all the work of the Bureau during those years is presented in abbreviated form.

The third edition of the *Handbook of American Trade-Unions* (Bulletin No. 618) which is now in press deals with the labor union situation as it existed in June, 1936. It covers the changes and developments in the labor movement that have occurred since the last edition of the handbook became available in 1929 and also gives the salient facts concerning the 156 national and international unions of the United States, including trade jurisdiction, government, methods of negotiating agreements and membership.

UNITED STATES EMPLOYMENT SERVICE.—*Survey of Registered Job-Seekers:* An analysis of the job-seekers registered with the public employment offices throughout the country at the close of 1935 compared with the similar registrations as of June 1, 1936, was recently completed by the Employment Service. This study is based upon an inventory system making use of detailed punched card records covering all active registrants with the Employment Service. Included in the analysis are data indicating the geographical distribution of registrants and information concerning the industrial background, occupational classification, age, sex, color, veteran and relief status.

A comprehensive report of the operations of the nation-wide system of employment offices during the two fiscal years ended June 30, 1936, was also recently prepared.

The Worker Analysis Unit and the Statistical Unit of the Occupational Research Program have completed work on a study of the potentialities required of workers in certain department store sales positions. A follow-up investigation has been undertaken, and additional data have been collected for a second study so that the validity of the criterion, the predictors, and the technical methodology used in the first investigation may be more fully determined.

The Editorial Group of the Occupational Research Program is working on an Occupational Dictionary. To date a preliminary draft of terms in the Construction Industry has been completed; this draft contains 1,800 occupational terms and titles which are in current use.

CHILDREN'S BUREAU, U. S. DEPARTMENT OF LABOR.—*Study of the Comparative Value of Certain Antirachitic Substances.* A study of the relative efficacy at different dosage levels, of cod-liver oil, viosterol, and several forms of vitamin D milk was completed recently in Detroit by the U. S. Children's Bureau, the Food and Drug Administration of the U. S. Department of Agriculture, and cooperating agencies and organizations in Detroit. This investigation was carried on during the winter months from 1933 to 1936. The antirachitics were administered at dosage levels ranging from 150 through 3,000 units to 567 infants, each of whom was observed from approximately one through six and one-half months of age. Diagnosis of rickets was based on X-ray plates of the bones of both forearms, taken at monthly intervals.

The results of this study demonstrate the necessity of considering such factors as color, sex, rate of growth in length, period of observation, and interval between examinations as basic when attempting to evaluate the efficacy of certain types of antirachitic substances in the prevention of rickets.

The evidence presented refers almost exclusively to the incidence of slight rickets as the dosage level was sufficiently high to prevent the development of moderate or marked rickets except in a few infants.

The incidence of rickets is significantly less among colored infants than among white for the different antirachitic agents, when all dosage levels were combined and, with few exceptions tends to be less, at different dosage levels.

When pertinent basic factors are taken into consideration, it becomes apparent that, despite their lower dosage level, the milks, especially those at 400 units, tend to be more effective in the prevention of rickets than cod-liver oil. There is also some evidence that viosterol is at least as effective as cod-liver oil. These results are not conclusive as the number of infants receiving any given number of units of a specific antirachitic is too small to give statistically significant findings.

There is no definite evidence from this study that one type of milk at the 400 unit level is superior to another in the prevention of rickets. Similarly, for the lower dosage levels no clear-cut conclusions with regard to comparative efficacy can be drawn.

The incidence of slight rickets has been shown to be closely and consistently related to growth in length when the dosage of the antirachitic is relatively high, whereas for infants in the lower dosage group there is no consistent difference in the incidence of rickets.

It would appear that if rickets is to be prevented or promptly controlled an amount of vitamin D must be given that will assure stability in the metabolic processes, providing for normal bone growth and allowing an adequate margin of safety for the rapidly growing infant. From the data here presented, this amount would appear at least as high as that contained in the usual dose of cod-liver oil; namely, two to three teaspoonfuls.

WOMEN'S BUREAU, U. S. DEPARTMENT OF LABOR.—A "Special Study of Wages Paid to Women and Minors in Ohio Industries Prior and Subsequent to the Ohio Minimum Wage Law for Women and Minors" has recently been released by the Women's Bureau as Bulletin 145. This study demonstrates the benefits that have accrued to women in Ohio through the application of the minimum wage law to the laundry and dry cleaning industries. In addition it traces women's growth in importance in the working population of the State, shows the variations in wages paid for the same work, compares wages and cost of living, explains why women's bargaining power is weak, and makes clear how even the better employers have been unable to remedy the situation.

Bulletin 146, entitled "A Policy Insuring Value to the Woman Buyer and a Livelihood to Apparel Makers," has just been released. This study outlines

the remarkable movement toward industrial stabilization in the coat and suit and the millinery industries and shows the important part the consumer may play in supporting high standards of working conditions.

"The Economic Problems of the Women of the Virgin Islands of the United States," Bulletin 142, will soon be available. This survey reviews the economic situation of women in the Islands and their meager opportunities for work, and suggests projects for the training and employment of women and the improvement of their living conditions.

Bulletin 144, a revision of No. 98, which brings up to July, 1936, the analysis of State labor laws for women, is in press.

Also in press is Bulletin 143, "Factors Affecting Wages in Power Laundries." The findings should prove of guidance value for employee, employer, and the public in their efforts to raise the industry to a high operating level. The study gives the amounts paid to employees during 1934, by sex and general occupation groups, in 22 cities in various geographic areas. Wage rates, hours, and fluctuation in employment are also discussed. Analysis is made of the relation between wage rates and prices charged for laundry services; the relation between laundry receipts and number employed and pay-roll expenditures, that is, dollar volume of business per operative and per productive pay-roll dollar; and the relation between productive labor costs and other costs. The report concludes that correction of fundamental defects in management in some laundries is necessary before all laundry employees will receive fair value for services rendered and the consuming public will pay only fair value for services received.

U. S. BUREAU OF MINES.—The Bureau of Mines is now engaged in a National Research Project involving an analysis of progress in mechanization and productivity for some of the major branches of mining. Work on the project is proceeding rapidly, and information of value to the mining industry is being obtained, although the results of the analysis will probably not be available for several months.

OFFICE OF EDUCATION.—Recent publications of the Office of Education of interest to statisticians are: Circular No. 162, "Federal Aid for Education," a brief history, data for 1934–35, and a bibliography. Circular No. 164, "The Average Cost Per Pupil for Plant Operation in Large City School Systems," for 1930, 1932, and 1934. Some data are also given for 1933 and 1935. Bulletin 1936, No. 3, "Junior Colleges."

The National Visual Instruction Survey has published through the American Council on Education a volume entitled *National Visual Educational Directory—A List by States of 8,806 School Systems, Including an Inventory of Audio-Visual Equipment.*

DIVISION OF RESEARCH, STATISTICS AND RECORDS, WORKS PROGRESS ADMINISTRATION.—*Works Program Statistics.* The employment series from the beginning of the Works Program has been revised to include all pay rolls which have been issued for W.P.A. projects. The employment reports for

other Works Program agencies have also been revised to include all pay rolls, many of which had been received too late to be included in the original tabulations. The regular employment reports have been revised to show separately the hours and earnings of women employed under the program.

The number of reports has been extended for administrative and research purposes to include special tabulations on employment made necessary by the drought, special analyses of hourly earnings and former relief status for persons employed by type of project and by county, and special reports dealing with employment on projects supervised by the various operating divisions of the Works Progress Administration.

As of September 15, 1936, the Division has taken an inventory of the physical accomplishments on W.P.A. projects, and the data are now being tabulated. All principal types of construction and non-construction projects are listed, together with appropriate measures of accomplishment in terms of physical units.

During the past six months the Division has issued the following publications: *An Analysis of Employment on Works Progress Administration Projects in December 1935*, which deals in detail with the various groups of workers employed on the program, together with assigned monthly wage rates and actual earnings. A study conducted in March was summarized under the title, *Average Monthly Wage Rates and Actual Earnings, W.P.A. Security Wage Workers, March 1936*. Data from a similar June tabulation are now being put in final form for publication, while a September study is being edited and tabulated.

A publication entitled *Statistical Reports Covering the Works Program*, outlining in detail the regular series of reports prepared by the Division was issued during June. Studies are now in progress concerning the turnover of workers assigned to W.P.A. projects and the amount of shift in employment from one Federal operating agency to another. A study of the hourly rates paid and the number of assigned hours of work on projects, by states and by skills, is being prepared.

Relief Statistics. Monthly relief statistics have now been published for the first six months of 1936. The data cover the number of families, cases and single persons receiving general relief, amounts of relief extended to cases by sources of funds and total amounts of obligations incurred by sources of funds. Because of the curtailment of the emergency relief program and the rising importance of other types of relief, the scope of the general relief statistics published for 1936 is somewhat larger than that for the data published for the emergency relief programs of 1933, 1934, and 1935.

Prior to January, 1936, the relatively small amount of relief, other than categorical aid and institutional care, extended from local funds in accordance with the provisions of the poor laws was not included in the reports received by the Federal Emergency Relief Administration. Since the late fall of 1935, as balances of the Federal Emergency Relief Administration funds became depleted and the emergency relief program was curtailed, relief of the types not formerly included in the regular monthly reports

greatly increased in importance in many areas. Much of the relief was administered by local agencies and local officials that were not associated with the emergency relief program. In order to maintain a comprehensive series the present objective is to include in the general relief statistics beginning with January, 1936, all relief given in accordance with the provisions of the poor laws (exclusive of institutional care and categorical aid). As a result, the data relating to general relief for months beginning with January, 1936, have in many instances a somewhat broader scope than data for previous months relating to the general relief program which was conducted as a part of the emergency relief program.

The number of states reporting data which are believed to be reasonably complete has varied from 40 states in January to 32 states in June. The 40 states reporting in January represent slightly more than 83 per cent of the total population of the United States. For a few of these states the data reported do not include all general relief given locally in accordance with the poor laws. It is believed that the volume of this type of aid not included is relatively small for the group as a whole. Since the data reported for the remaining states are complete only for certain counties or are known to be incomplete, estimates for this group of states have been prepared in order to arrive at totals for the Continental United States. It is hoped that at a later date missing data will become available for at least a part of the states.

In order to facilitate the development of general relief statistics an interim arrangement has been made between the Social Security Board and the Works Progress Administration.*

The following recent publications which contain statistics of general relief activities may be obtained from the Works Progress Administration: *Monthly Report of the Federal Emergency Relief Administration for March 1936; Monthly Report of the Federal Emergency Relief Administration for April 1936; Trend of Relief in the Continental United States from May to June 1936; Trend of Relief in the Continental United States from June to July 1936; Trend of Urban Relief from June to July 1936; Trend of Urban Relief from July to August 1936.*

Distribution of Relief Funds Among the Political Subdivisions of the States. This study, recently completed, examines the methods employed by states in determining the various cities' and counties' shares of available state and Federal funds. Attention is devoted both to the bases of distribution prescribed by state statutes as well as those evolved by state relief administrations. The methods employed in determining need for relief funds are treated separately from those determining the abilities of local units themselves to supply these requirements. This study will be published soon in the *Monthly Report of the Federal Emergency Relief Administration.*

Relationship between Relief Programs and the Status of Labor. The Division has inaugurated an investigation into the relation between the various relief programs and the status of labor in the country. During the summer months a group of economists studied the relief problem in its relationship

* See p. 736.

to the status of labor in 33 communities in the United States. In connection with the conduct of this investigation, a study has been made of the methods of establishing prevailing rates which have been used by various agencies of the Federal government and under the various state laws. Data have also been gathered on rates of wages for the entire country. These data are being recorded on standard cards in order that they may be useful not only for the purposes of the investigation but for the use of any other agency. Several other Federal agencies, especially the Bureau of Labor Statistics and the Bureau of Agricultural Economics, have undertaken to cooperate with the Works Progress Administration in conducting statistical studies of actual rates of wages throughout the country.

NATIONAL RESEARCH PROJECT, WORKS PROGRESS ADMINISTRATION.—In the September notes of the JOURNAL, the activity of the Project was briefly outlined as it stood in July. As of October first considerable progress has been made and some new lines of study have been developed.

Survey of Productivity in Selected Industries. Field work in cooperation with the Bureau of Labor Statistics is under way in the following industries: boots and shoes, shoe machinery, leather, textiles, men's clothing, cotton garments, cigars and cigarettes.

Field work on studies conducted in cooperation with the National Bureau of Economic Research—in the brick and tile, lumber, cement, beet sugar, and flour milling industries—is, with the exception of flour, largely completed. The beet sugar study includes a survey of productivity of central office work. In addition, a study of the machinery and equipment industry has been undertaken with the objectives of, first, obtaining measures of labor needed to produce the machines used in the other industries studied, and, second, determining trends in the development of certain types of machines.

Field work covering a study of changing farm practices has been completed. Some 4,200 records were obtained from farms in 58 counties in dairy, corn, cotton, small grain, and fruit and vegetable producing districts. Secondary statistics on acres planted, production, labor requirements, technology, etc., are being compiled from data available in the U. S. Department of Agriculture. Similar cooperation is also being received from the agricultural schools of Cornell University, the University of Illinois, and the Giannini Foundation of the University of California.

The construction unit in the Division of Research, Statistics and Records of the Works Progress Administration is cooperating on a productivity study of the construction industry.

An historical study of technological developments in the railroad industry in relation to the changing volume of services and employment furnished is being conducted as a joint project with the Railroad Retirement Board. As noted below, this study also contemplates an extensive analysis of occupational histories of railroad employees.

In cooperation with the Bureau of Mines and under the supervision of

members of its staff, tabulations are being made covering changing productivity in the extractive industries.

Surveys of the Effects of Industrial Changes on the Labor Market and on Individual Workers. Surveys are being made to gather information on the relationship of employment and unemployment experience and occupational changes to selected industrial situations. The selection of the groups to be studied is governed by the need for illustrating various types of employment and unemployment situations which are related to changes in industrial techniques. Among the groups of workers chosen are included labor aggregations which in themselves constitute an entire community—both new industrial communities and "stranded" communities. Studies are under way in 14 localities ranging geographically from Massachusetts to Minnesota.

As part of the Railroad Retirement Board study mentioned above, a record of changes in the occupational and employment status of 400,000 employees of 14 railroads will be analyzed. This will be supplemented by a field study of the occupational histories of selected samples of workers who have been employed in the industry.

DIVISION OF SOCIAL RESEARCH, WORKS PROGRESS ADMINISTRATION.—In order to provide a running, month-to-month record of the types and amounts of public assistance extended to families in a number of sample counties in the drought areas, a *Survey of Public Assistance to Households in Drought Areas* has been initiated.

The information needed for the *Study of Public and Private Assistance in Rural and Town Areas* (reported in this JOURNAL, June, 1936) has been received regularly from the 36 states participating.

A survey has been made in cooperation with the Department of Labor in order to obtain information on the current transient and homeless problem for inclusion in a report to Congress on the movement of workers across state lines, as called for in Senate Resolution 298.

Among the *Research Bulletins* released during the past few months are included: Series I, No. 20—Inter-City Differences in the Cost of Living; Series I, No. 21—Quantity Budgets for Basic Maintenance and Emergency Standards of Living; Series I, No. 22—Source of Income of Former Urban Relief Cases; Series III, No. 1—Cases Receiving General Relief in Urban and Rural Areas, July 1933–December 1935 (Estimated); Series IV, No. 1—Survey of Cases Closed from State Emergency Relief Administration Rolls in 12 New Jersey Communities.

It is expected that the following final reports will be completed by the end of 1936: *Urban Workers on Relief in May 1934.* Findings of the Survey of Occupational Characteristics of Workers on Relief in 79 Cities, May 1934. *The Changing Aspects of Urban Relief.* Presentation of data collected in the Survey of Current Changes in the Urban Relief Population, 13 cities, 1935. *The Cost of Living in Urban Areas.* Based on Survey of Living Costs conducted in 59 cities in 1935. Cost of living of industrial, service, and other manual workers of small means at a maintenance and at an emergency

standard; relative costs in separate cities; causes of cost variation; detailed budget. *Migrant Families.* Residence history; transient relief history; personal characteristics; occupational characteristics; reasons for migrations; origin and destination. *Workers on Relief in the United States, March 1935.* A census monograph including statistics on the usual occupations, age, color, urban-rural place of residence, and sex, of over 6,000,000 workers on the relief rolls, including over 4,000,000 economic heads of relief families. *Landlord and Tenant on the Cotton Plantation.* Recent social and economic trends in cotton areas, management and organization of plantations. Landlord and tenant education, standards of living, incomes, and relief. *Part-Time Farming in the Southeast.* An analysis of southeastern industries and agriculture with relation to part-time farming and of a field study in five sub-areas of the Southeast (textile, steel, lumber and naval stores, and coastal plain). *Farmers on Relief and Rehabilitation.* Description of the trend of farm operator relief, transfers to rehabilitation program, character and amount of relief and rehabilitation grants. Shifts to and from agriculture and farm and family characteristics of clients. *The Rural Family in the Depression.* Family characteristics of relief cases. Special problems of women, youth, children and the aged. *Rehabilitation in the Drought Area.* Analysis of 13 sample counties in the drought stricken area with description of the extent to which government programs have alleviated conditions and the extent to which distress is relatively permanent.

DIVISION OF PLACEMENT AND UNEMPLOYMENT INSURANCE, NEW YORK STATE DEPARTMENT OF LABOR.—Since the publication of a descriptive note on the organization of the Division of Placement and Unemployment Insurance in the September issue of the JOURNAL, the Bureau of Research and Statistics of the Division has brought together a nucleus of its technical staff, by means of provisional appointments and by transfers from other departments of the State service in accordance with the State civil service regulations. It is expected that competitive examinations for these and other positions will be arranged after the constitutionality of the New York State Unemployment Insurance Law has been determined by the U. S. Supreme Court.

A program of occupational studies, the foundations of which were laid by the New York State Employment Service, has been brought under the direction of the Bureau of Research and Statistics. Field and analytical work under this program is being conducted in cooperation with WPA and the U. S. Employment Service. At the present time the supervisory personnel for this work is provided by the National Reemployment Service.

HARVARD UNIVERSITY.—At the Harvard Tercentenary Conference the very distinguished statistician, R. A. Fisher, gave a lecture on "Uncertain Inference." This essay will appear shortly in the *Proceedings* of the American Academy of Arts and Sciences in Boston. The degree of Sc.D. was conferred on Professor Fisher.

NATIONAL BUREAU OF ECONOMIC RESEARCH.—*Prices in Recession and Recovery, a Survey of Recent Changes*, by Frederick C. Mills, was published on November 30. It presents various materials gathered under Dr. Mills' supervision at the National Bureau the last several years. The chapter headings are as follows: (I) General Aspects of Recent Price Movements; (II) The Pre-Recession Situation; (III) Price Movements and Related Economic Changes during Recession and Depression; (IV) The World Price Structure in Recession and Recovery; (V) Price Changes and the Fortunes of Primary Producers in Recovery; (VI) Manufacturing Industries in Recovery; (VII) Capital Equipment and Construction in Recovery; (VIII) Consumers' Goods in Recovery; (IX) The Price System, Increasing Productivity and Recent Economic Changes.

Dr. Macaulay's *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States Since 1856* will be published by the end of the year. This book is the outcome of a long-continued study of interest rates. It has a large statistical appendix as well as many charts, six of which are inserts.

A report by Simon Kuznets on capital formation, giving the statistical results of his survey, is planned for early publication. A preliminary draft has been mimeographed.

For those interested in Dr. Mitchell's study of business cycles, mimeographed copies of the first three chapters of *Business Cycles*, Volume II, *Analysis of Cyclical Behavior*, have been prepared and are available on order. The first chapter states the aim that guides the investigation, the second describes the technique employed, the third presents statistical tests of the representativeness of the various measures secured by applying this technique. Number 61 of the National Bureau *Bulletin*, published on November 9, was entitled "Production During the American Business Cycle, 1927–1933," by Dr. Mitchell and Dr. Burns. Copies of both this *Bulletin* and *Bulletin 57*, which described the National Bureau's study of business cycles, are available.

Under the direction of Dr. Willits, newly-appointed Executive Director of the National Bureau, plans for the continuing program of cooperative research are being developed. In furtherance of this program, a series of conferences and discussion groups were held this autumn under the sponsorship of the National Bureau. A start upon this activity has been made in connection with the Conference on Price Research and the Conference on National Income and Wealth.

WHARTON SCHOOL OF FINANCE AND COMMERCE, UNIVERSITY OF PENNSYLVANIA.—The Industrial Research Department is undertaking a study for the Textile Foundation of the organization of production and distribution in the textile industries. This study is being made for the purpose of throwing light upon: (1) the factors which influence the nature and extent of vertical integration in the textile industries; and (2) the apparent effects of vertical integration in these industries.

In dealing with vertical integration, attention is being given not only to the direct linking of two or more stages of production or distribution through ownership, but also to various indirect methods such as the granting of exclusive agencies by sellers and the contracting for all or a substantial part of a producer's output by large buyers, frequently on a commission basis. Data for the study are being obtained for the most part through analyzing the experiences of selected companies which have in some way tried to link together two or more stages of production or distribution in the textile field. The companies selected include textile manufacturers, commission houses, converters, jobbers, garment manufacturers, wholesalers, and retailers.

The study is being made in cooperation with the Committee on Economic Research of the United States Institute for Economic Research and the presidents or managing directors of 12 textile trade associations. The following members of the Industrial Research Department are participating in the study: Anne Bezanson, C. Canby Balderston, George W. Taylor, Hiram S. Davis, Miriam Hussey, Robert D. Gray, G. Allan Dash, and Robert B. Armstrong.

The Industrial Research Department has recently completed a study on hourly earnings of employees in the hosiery industry. The National Association of Hosiery Manufacturers cooperated in the survey that was the basis for the report, the results of which have been published in a monograph entitled, "Recent Changes in Hourly Earnings of Employees in the Hosiery Industry," by George W. Taylor and Lillian P. Goodman.

Hourly earnings data were secured for each occupational group in the full-fashioned and seamless branches of the hosiery industry for selected weeks in 1929 prior to the depression, in 1933 at the depth of the depression, and in 1934 and 1935 when the industry was subject to the terms of an N.R.A. code. The 25 statistical tables in the report analyze the trends in hourly earnings by occupation and by principal producing areas.

The Industrial Research Department announces the completion of a second volume in its series of the history of prices in Philadelphia. This volume, and the supplementary one giving source material, deal with the significant fluctuations in wholesale prices from the close of the Revolution to the outbreak of the Civil War. Series for commodity groups representative of various producing areas of the economy are included in the interpretation. It is anticipated that the next study in this series, upon which work has just started, will make available data to extend the groups and individual commodities to the nineties in order to overlap modern price data.

"Migration and Economic Opportunity" is the title of the book by Dr. Carter Goodrich and his associates, of the Population Redistribution Study, affiliated with the Industrial Research Department of the University of Pennsylvania. The book has been published by the University Press.

Professor Hans Neisser of the Wharton School has completed his book on "International Factors in the Cycle of Prosperity and Depression."

NATIONAL INDUSTRIAL CONFERENCE BOARD.—The volume, *Private Long-Term Debt and Interest in the United States*, prepared by Leonard Kuvin,

issued September, 1936, contains a discussion of the growth and composition of such debt, and the interest charges on it. The period covered is from 1900 to 1925. The Appendix gives notes on the methods of estimating debt and interest.

The volume, *Wages, Hours, and Employment in the United States, 1914-1936*, prepared by M. Ada Beney, was issued September, 1936. It contains an exposition of the Conference Board's procedure in the measurement of wages, hours, and employment and the scope of its researches. The trend of wages is discussed briefly, but the body of the book consists of about 150 pages of tables in which all the results of the Board's monthly inquiry down to June, 1936, are presented in great wealth of detail.

Studies in the field of national income are being supplemented by a discussion of *Agricultural Income*, the work of Mr. Robert F. Martin, which is now in press. A study of *Unemployment and Relief with Special Reference to the United States* is being prepared by Mr. Vaso Trivanovitch.

In a recent reorganization of the Board's staff, Mr. Robert F. Martin was appointed Director of Research.

NEW MEMBERS

Balderston, Dr. C. Canby, Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania

Best, Dr. Harry, University of Kentucky, Lexington, Kentucky

Casanova, Dr. Teobaldo, Assistant Professor of Psychology, University of Puerto Rico, Rio Piedras, Puerto Rico

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Eisenhart, Churchill, Research Student, Department of Applied Statistics, University College, London, W. C. 1, England

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Kuznets, Solomon, Statistician, U. S. Bureau of Labor Statistics, Department of Labor, Washington, D. C.

Lemm, Frederick L., Assistant Secretary-Treasurer, Tom Huston Peanut Company, Columbus, Georgia

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REVIEWS

Examples in Finite Differences, Calculus, and Probability, by Harry Freeman. Cambridge: at the University Press. New York: The Macmillan Company, Published for the Institute of Actuaries. 1936. 86 pp. $2.50.

How does one review a book of problems? Does one say merely, "This is a book of 400 problems, with their answers and 26 pages of notes?" Does one attempt to read it entire, as one would a treatise on psychology or logic, and set down the monumental thoughts which it evokes? Does one classify all the problems and give complete statistics on the accuracy of the answer book? Or, finally, does one write an essay on the impossibility of reviewing such a book?

Faced with this dilemma (or is it polylemma?), your reviewer has done no more than survey the book in a cursory way, in order to form a general impression as to the nature and merits of its contents, and make a spot check by solving a small number of problems which happened to catch his eye.

The impression produced by the general survey was a decidedly favorable one. Mr. Freeman's idea of providing a problem supplement for his "An Elementary Treatise on Actuarial Mathematics" is praiseworthy. The problems constitute a wide, well-balanced list with a liberal sprinkling of thought-provoking questions interspersed among others of a more routine drill type. The notes and hints are interesting and illuminating and frequently suggest unexpected methods of solution well calculated to broaden the repertoire of the thoughtful and resourceful student. The list of answers is complete. Indeed, at this point, your reviewer would have been inclined to recommend the book without qualification.

Such reservations as he may now have arose from the spot check. While it is necessary that they should be added to the record, it should also be pointed out that they do not entirely reverse the first favorable impression: for the sample is much too meager to be accepted as representative, and the only defect revealed was carelessness in small matters, which, though annoying, is not likely to be otherwise harmful.

Specifically, the spot check consisted of eleven problems. One of these (number 294) deals with a rather recondite matter and had best be left out of account, for, though the majority of experts would doubtless disagree with Mr. Freeman's comments on it, they would likewise disagree among themselves. Of the remaining ten, about which positive statements can be made, only six are unimpeachable as to statement, answer, and notes. The others are in error in various minor ways, as follows:

Problem 240 is misstated, as is obvious from the restatement in the note on page 66. Problem 297 has two sets of answers, of which one ($p_1 = 0.436$, $p_2 = 0.279$, $p_3 = 0.205$) is not given. Problem 354 also has a second set of answers, which may be obtained by interchanging p and $1-p$. A strict interpretation of problem 392 leads to the answer zero. That given by Mr. Freeman is the mean *absolute* difference in length.

At this point the spot check was stopped, partly no doubt through laziness; partly also to avoid further irritation at the carelessness of an otherwise capable author. But the book is still a good one. Forewarned of its one defect, students and teachers in the broad field of statistics and probability should find it exceptionally helpful.

THORNTON C. FRY

Bell Telephone Laboratories, Inc.

Wahrscheinlichkeit, Statistik und Wahrheit, by Richard von Mises. Vienna: Julius Springer. Second edition, 1936. viii, 282 pp. RM. 16.

This second edition of a book that appeared as a first edition in 1928 brings up to date the developments and discussion of a definition and theory of probability which Mises set forth in 1919, first in popular form under the title: "Marbes 'Gleichformigkeit in der Welt und die Wahrscheinlichkeitsrechnung,'" and then as "Grundlagen der Wahrscheinlichkeitsrechnung" in Mathematische Zeitschrift, Vol. 5 (1919), pp. 52–99.

Mises maintains (p. 21) that the phrase "probability that a designated man of specified age will die within a year" has no meaning in itself. There must be specified further the group of individuals in which the man is to be considered; and this, indeed, is arbitrary—the group might embrace all men and *women* of the given age in the world, or merely men in a given country with given occupation. Mises requires (p. 33) as preliminary to any definition of probability a fully specified assemblage, set, or collective (Kollektiv) of individuals or objects—conceivably infinite in number. A probability is then the limit—for n increasing indefinitely—of the ratio of the number of objects having a specified characteristic among the n objects under consideration. Two axioms must be satisfied: First, the limit just mentioned exists; second, the limit remains unaltered in any subset selected from the given set on the basis of *position* alone. For example, if 2, 5, 4, 6, 5, 3, 1, . . . are the throws of a die, and if in the limit the 5's appear $\frac{1}{6}$ of the time in the given set; then also in the set obtained by selecting the alternate throws, 2, 4, 5, 1, . . . the 5's must appear $\frac{1}{6}$ of the time.

Mises distinguishes his theory from: (1) the theory of Laplace and his followers who use "equally likely cases"; (2) the theory of Venn, Fechner, Bruns, and Helm, who use the first axiom without getting to the second; the theory of Copeland (p. 116), Reinhenbach, Popper, Tornier, Kamke, and Dörge, who in some way restrict the arbitrariness of the choice of the choice of the subset under Axiom II. Copeland, it should be noted, proved that there *exist* sequences of numbers satisfying both axioms provided the subset is to be selected from the given set $a_1, a_2, a_3, \ldots$ by taking the subscripts or *position numbers in any arithmetic progression*.

Mises takes up in a frank and delightful manner the objections that have been urged against his theory. Although defending his axioms, he does not consider (p. 114) that the last word has been spoken. He mentions (p. 119)

the psychological aspect of Axiom II. Now Mises is interested in *objective* probability—not *subjective* probability, such as is implied in Lourie's definition that probability is the science that *systematizes* our *ignorance;* and the *arbitrary position* selection, required by Mises in Axiom II, seems to possess a certain psychic or subjective aroma. Suppose a set of numbers, like the throws of a die, laid down or in the course of being run off. *Objectively* considered, there exist certain sequences of *position* numbers which if used would violate Axiom II. The point seems to be that no human *mind* can devise a rule for getting these numbers. In Copeland's modification of Axiom II, the subjective element disappears. But this limitation to arithmetic progressions is much more restrictive than desirable (p. 116). The Mises Axiom II implies that in a Monte Carlo game no system of play will improve the player's chance of winning. Mises regards the failure of all the many devised systems at Monte Carlo as empirical evidence of the substantial exactitude of his Axiom II (p. 30).

Of greater interest to many readers will be the chapters which connect this Mises theory of probability with modern developments in physics and mechanics. For example, the Heinsenberg Principle of Indeterminacy is set forth (p. 259) in a most instructive manner; also, its relation to the collectives used to define probability. In fact, modern physics with its quantum theory and wave mechanics requires the theory of probability for its proper expression.

The bibliography gives the names of 140 authors, with more than one reference to most of them, and with more than 30 references to Jacob Bernoulli and to Poisson.

The book is marvelously devoid of mathematical technique, although it gives (Chapter II) in condensed form the main features of the Mises theory. The reader also finds easily understandable references to so many important problems of statistics and probability. To those especially interested in foundations and ultimate conceptions, the book will be of extremely great value.

EDWARD L. DODD

University of Texas

Tables of the Higher Mathematical Functions, Vol. II. Computed and compiled under the direction of Harold T. Davis, Indiana University and the Cowles Commission for Research in Economics. Bloomington, Indiana: The Principia Press. 1935. xiii, 391 pp.

The tabular material of the present volume is divided into three main divisions:

(1) The Trigamma function $d^2/dx^2 \log \Gamma(x)$ and its first three derivatives (Tables 13 to 28). The total range covered is the same for all four functions, from -10 to 100; the number of decimal places given varies from 10 to 17 according to the function and sub-range. Central differences are given for positive x.

(2) The Bernoulli and Euler Polynomials and Numbers (Tables 29 to 39). This section includes $B_n(x)$ and $E_n(x)$ for $n=2, 3, 4, 5, 6, 7, 8$ and x ranging by hundredths from .01 to 1.00; the exact values of the first 90, logarithms and first 9 significant figures of the first 250, of the Bernoulli and Euler numbers; coefficients for Lubbock's Summation Formula; sum of the nth powers of the first p integers.

(3) Gram Polynomials (Tables 40 to 49). The fitting of a series of evenly spread data to a polynomial curve of the nth degree is effected directly from these tables as soon as the first n noments are obtained, for $n=1, 2, 3, 4, 5, 6, 7$.

A short account is given in each section of the formulae and methods used and of other existing tables, a very pleasing feature. Reasonable precautions appear to have been taken to insure accuracy. The last part of the closing sentence on page 331 is missing. There is a peculiar lack of uniformity as to the repetition of an entry, occurring at the bottom of a column, at the head of the next column. The printing is clear and the general arrangement pleasing. The present volume is a welcome addition to Volume 1 of the same series, and it is to be hoped that the next volume will appear in the not too distant future.

JOHN D. ELDER

University of Michigan

British Association Mathematical Tables. Vol. V. London: British Association for the Advancement of Science. *Factor Table,* prepared by J. Peters, A. Lodge, E. J. Ternouth, and E. Gifford.

This volume gives the complete factorization of every integer less than 100,000. There is also included at the end of the book a table of the reciprocals of the first 10,000 integers.

In such a factor table the all-important question is that of accuracy. The introduction sets one's mind at ease on this point. At every stage in the preparation extraordinary precautions have been taken to eliminate error. Three completely independent copies have been prepared, and proofs have been read six times, against all three copies. The statement found in the introduction that " . . . there is thus every reason to believe that no errors exist . . . " seems well justified.

The arrangement and printing is, of course, exceptionally good, and the resulting volume fills admirably a long-felt need.

JOHN D. ELDER

University of Michigan

Statistical Research Memoirs, Volume 1, edited by J. Neyman and E. S. Pearson. Cambridge: Cambridge University Press. June, 1936. 161 pp. 15 s.

This is the first of a series of semi-periodical publications which will be issued annually from the Department of Statistics, University College, University of London. The *Statistical Research Memoirs* are being published

in continuation of a 30-year-old tradition established in 1904 by the appearance of the first *Drapers' Company Research Memoir*. The succession of publications which were issued throughout this period from the Galton Laboratory under the direction and editorship of Karl Pearson covered a wide range of subjects, including statistical theory, computing tables, and investigations in biometry, medicine, anthropology, and eugenics. The new series is to be devoted more specifically to the development of statistical theory and is to contain only papers prepared in the Department of Statistics at University College. The increased specialization of content in the new series is due, to some extent, to the reorganization of the Galton Laboratory into two distinct departments upon the retirement of the elder Pearson in 1933.

The present issue contains seven papers, all of which deal with certain special cases and further investigations in the theory of testing statistical hypotheses. Neyman and Pearson have approached the problem of testing statistical hypotheses from two points of view. The first method, which was based on the maximum liklihood idea was introduced in a paper published in *Biometrika*, XXA, 1928, pp. 175–240, 263–294. Here they distinguished between *simple* and *composite* hypotheses. More specifically, if H_0 is a *simple* hypothesis the probability $P\{A \mid H_0\}$ of a set of observed facts A is completely specified. H_0 is tested in the light of a set of admissible hypotheses Ω by means of the likelihood ratio

$$\lambda_0 = \frac{P\{A \mid H_0\}}{P\{A \mid \Omega \max\}},$$

Where $P\{A \mid \Omega \max\}$ is the least upper bound of the probabilities of the same facts A for all possible simple hypotheses in Ω. Similarly, a *composite* hypothesis H_c only partially specifies the probability of the facts A and asserts that the completely specified probability of the facts is a member of a set ω of simple hypotheses; ω being a subset of Ω. The criterion for testing H_c is defined as

$$\lambda_c = \frac{P\{A \mid \omega \max\}}{P\{A \mid \Omega \max\}},$$

where $P\{A \mid \omega \max\}$ has the same meaning for ω as $P\{A \mid \Omega \max\}$ has for Ω. Increasing values of λ_0(or λ_c) from 0 to 1 are regarded as corresponding to increasing strength of support of the hypothesis H_0(or H_c) by the facts A. For a given amount of risk of error in rejecting H_0(or H_c) when it is true a critical value of λ_0(or λ_c) is found from the probability function of λ_0(or λ_c) when the hypothesis H_0(or H_c) is true.

In their newer approach to the problem of testing a simple hypothesis H_0 Neyman and Pearson begin with the fundamental sample space W of the facts A and determine critical regions which have the property that for a given risk of error (of first kind) in rejecting H_0 when it is true, the error (of second kind) is minimized in accepting H_0 when it is false, that is, when an alternative hypothesis H' is true. The ideas have been extended to composite hypotheses and conditions have been obtained for the existence of *common best critical regions* with respect to a set of alternatives. In situations where no common best critical regions exist, the idea of *unbiased critical*

regions has been introduced and treated by the editors themselves in paper No. 1 of the present volume. Certain connections have been established between statistical functions characterized by R. A. Fisher as *sufficient statistics* and best critical regions, but it is shown in paper No. 6 that the existence of the one does not imply the existence of the other. Numerous papers have appeared in scattered journals by various authors on the theory and application of these two methods of approaching the problems of testing hypotheses.

Much of the practical statistical inference which is needed in experimental work can be reduced to a procedure of testing what Neyman and Pearson called *linear hypotheses*, which in turn depends on least squares and normal probability theory. The possibilities here have not been exhausted. For example, the technique of introducing dependent variables which take only the values 0 or 1 has scarcely been touched in the field of statistics. By this scheme the methods of Analysis of Variance and Covariance devised by R. A. Fisher, and many other problems involving both quantitative and qualitative variables can be reduced to least-square problems and their associated matrices of second-order products. These matrices provide an algebraic basis for defining such notions as degrees of freedom, interaction, orthogonality, etc. Paper No. 4, by P. O. Johnson and Neyman, deals with certain educational problems in which the analysis is reduced to problems in testing linear hypotheses.

Paper No. 5, by P. V. Sukhatme, consists of an application of the likelihood procedure for testing certain hypotheses about k samples from exponential populations. Paper No. 7, by R. W. B. Jackson, is concerned with the testing of hypotheses when the admissible hypotheses are characterized by a variable taking on discrete values; illustrated by a simple problem in genetics. The remaining two papers, one by P. P. N. Nayer and the other by B. L. Welsh, are shorter notes on the Neyman-Pearson L_1 test.

There is a definite need, particularly for academic purposes, of systematically building the theory of statistical inference on a few clearly expressed principles; otherwise problems which can be handled methodically by commonplace methods will continue to appear to require fresh intuition for their solutions. The editors have virtually expressed their intentions of using the *Statistical Research Memoirs* in such a program. Those interested in some of the most recent developments in the theory of statistics will find this series most valuable.

S. S. WILKS

Princeton University

Studies of Differential Fertility in Sweden, by Karl Arvid Edin and Edward P. Hutchinson. London: P. S. King & Son, Ltd. 1935. 116 pp. (May be purchased from the Population Association of America, 308 Victor Building, Washington, D.C.)

Students of population have awaited with much interest the appearance of this volume. It has been several years since Karl Arvid Edin first re-

ported a most unusual type of association between fertility and social status in Stockholm, Sweden. Unfortunately, the major results of his studies appeared only in Swedish. The brief and scattered reports in English aroused such interest that arrangements were made with the Social Science Research Council to have Edward P. Hutchinson of Harvard University collaborate in analyzing the data and in bringing out the present volume. The report consists of an introduction concerning Swedish official data and the measures of fertility available from them, a chapter relating to differential fertility in rural areas of Sweden, two consecutive chapters dealing with birth rates according to social-economic status in Stockholm, and a summary.

Full advantage seems to have been taken of the exceptional opportunities afforded by the demographic statistics of Sweden. Since 1750 the local parish registers have formed the bases of Swedish population statistics. These contain, among other items, individual records of birth, marriage, occupation, in-migration, out-migration, and death. Since 1860 abstracts from these registers, rather than direct enumeration, have been used for the Swedish decennial census. In their various analyses the authors used both the registration and census data. Some of the procedures entailed the identification or "matching" of families in the two sources. In one instance the data were restricted to families identified in both the 1920 and 1930 census reports. To insure accuracy of occupational returns and to make possible the division of families according to income and educational status of husbands, the family names were checked with lists of household registration for income taxes and with income tax returns.

Before considering the exceptional situation in Stockholm the authors present data to indicate that, in some respects at least, the fertility differences observed in rural sections of the Malar Counties of Sweden are consistent with those observed in other western countries. The measure of fertility used was based upon the number of registered confinements in 1930 and 1931 per thousand married women 15–44 years of age (as determined by the December 31, 1931 Census). The areas considered were divided into four "community groups" on the basis of "degree of ruralism" as determined by percentages engaged in agriculture. Each "community group" was divided into three broad occupational groups: agricultural laborers, others engaged in agriculture, and non-agricultural workers. The chief points of interest here were: (1) fertility declined with decreasing ruralism, (2) fertility was highest among agricultural workers and lowest among non-agricultural workers, and (3) occupational differences in confinement rates persisted within each type of community. Such findings are not unlike those observed in other western countries.

In Stockholm, however, a direct association between birth rates and social-economic status was found. The first set of data bearing on this situation pertained to live births during the four years 1919–1922 among unbroken Stockholm families in which wives were under forty years of age at the Census of December 31, 1920. The number of families meeting the above requirement was over 39,000, and these were classified according to occupa-

tional and income status of husbands. The four occupational groups included (a) workers in industry and unskilled day laborers (b) technicians, overseers, and office workers in industry, (c) trade and commerce pursuits, and (d) arts and professions. Each occupational group was subdivided according to income of husband in 1920 into the following classes: (1) Under 4,000 kronor, (2) 4,000–6,000, (3) 6,000–10,000, and (4) 10,000 and over.

The number of live births per thousand years of married life (standardized for age of wife and period of marriage) was computed for each of the above occupational-income groups. On the whole, the rates indicated a *direct*, rather than an *inverse*, association between fertility and social status. The fertility of industrial workers and day laborers was below that of the "upper" occupational groups, but the birth rates of the three "upper" groups were strikingly similar. There was, however, a consistent increase in birth rates with improved income status, and this situation persisted within each occupational class, except that of the workers and laborers.

On the hypothesis that the unusual situation in Stockholm might have been due to abnormal conditions in 1919–1922, intramarital fertility was investigated for a longer period, 1917–1930. The data employed related to all families in Stockholm meeting the following requirements: (a) marriage during 1917–1920, inclusive, (b) wife under 35 years of age at marriage, (c) husband and wife living together in 1920 and 1930, (d) family identified in the censuses of both years. Although the number of families meeting the above requirements was only 6,629, the data used permitted the analysis according to such factors as date and duration of marriage, ages of husbands and wives at marriage, income of husband in 1920, and education of husband as reported in 1930. With the above method the social class differentials in fertility were similar to those observed during the period 1919–1922. This was true for each of the dates and durations of marriage investigated. Further, within each income level, fertility rates increased from the lowest to the highest education groups. The persistence of this situation in crude as well as in standardized rates indicates that it is real and that it is not merely dependent upon standardization of ages or duration of marriage.

Throughout the report the authors have generally succeeded in acquainting the reader with the nature and limitations of the basic data, procedures and results. Many side-analyses were made which afford at least suggestive answers to questions concerning results. Perhaps practical considerations prevented a badly needed further exploration of the relation between occupation and fertility in Stockholm. We have seen that the direct association between fertility and social status was only partially manifested when occupation was used as the sole criterion of social status. The authors admit that the occupational classes lack specificity, but a further weakness is the meager and indefinite description afforded by the authors. The system used was apparently a hybrid occupational-industry classification. A sharper division of the white collar pursuits from manual labor and a clear-cut division of manual work on the basis of skill would have been more satisfactory.

The report is well organized, brief, and compact. Some readers may regret the absence of any discussion of local factors underlying this unusual situation in Stockholm. Such, however, was not within the province of this statistical investigation. Further data concerning social class differentials in birth rates will be available from the Swedish Census of 1935–1936. This census was motivated by the recently appointed Population Commission and, according to report, will include entries concerning economic status, occupation, and number of children born to unbroken unions.

CLYDE V. KISER

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The Growth of the Surface Area of the Human Body, by Edith Boyd. Foreword by Richard Scammon. Minneapolis: The University of Minnesota Press. 1935. x, 145 pp. $5.00.

Dr. Boyd has reviewed in her monograph all the literature on the measurement and estimation of the surface area of the human body and has tabulated the data on 1,114 subjects. Most of her calculations are based on 231 subjects for whom the data were reasonably complete. She has analyzed statistically the various methods of measurement and 36 formulae for the estimation of body surface.

The surface area of the body of human subjects and experimental animals has assumed greater prominence during the last two decades and at present is employed by many physiologists as a basis of reference for estimating basal metabolism, vital capacity, cardiac output, etc. Dr. Boyd is particularly interested in the anatomical relationship to growth and has included in her studies the prenatal as well as the postnatal period.

She believes that the principal methods of measuring surface area can, in the hands of competent workers, be repeatedly applied to the human body within a total range of error of less than 3 per cent but that integration tends to give values 4 per cent lower than coating or triangulation. She believes that estimations made by the linear methods give results within ±10 per cent of the measured surface area. The analysis of the many formulae for estimating surface area from weight or height or weight and height together shows that those suggested in recent years are reasonably accurate. The old Meeh formula when $S = K \times W^{2/3}$, in which S equals the surface in square decimeters, K the constant 12.3, and W the weight in kilograms, gives results distinctly too high but with K between 10 and 11 this type of formula remains useful. Better results are obtained with exponents of W a little higher than 2/3. The height-weight formula of the Russell Sage Institute of Pathology has been used a great deal since 1915, but Dr. Boyd shows that about a dozen other formulae give results slightly more accurate. Her statistical analysis indicates that the best formula from weight alone that will apply in prenatal and postnatal periods is the self-adjusting power equation $S = 4.688\ W^{0.8168 - 0.0154 \log W}$. Somewhat better results are obtained by intro-

ducing the factor height, $S = 3.207\ W^{0.7285-0.0188\ \log W}\ H^{0.3}$. She finds the probable limits of normal variation for these ± 16 and ± 14 respectively. The formulae given by Boyd are complicated and their application is facilitated by the tables in her book.

This small monograph is carefully written, and it contains many valuable tables and figures. It will doubtless remain the standard work of reference for many years.

EUGENE F. DU BOIS

New York Hospital

An Introduction to the Mathematics of Life Insurance, by Walter O. Menge and James W. Glover. New York: The Macmillan Company. 1935. ix, 190 pp. $2.60.

Strange as it may seem, this book appears to cover a really distinct field compared with that of any previous book in English. It covers the elements of actuarial science. Of course it makes no pretense of being a thorough treatment such as that given in *Life Contingencies*, by E. F. Spurgeon. On the other hand, it is much more comprehensive than the elementary books that have been written, not only such as those dealing principally with the subject of interest and annuities with some space devoted to life contingencies but also such as the old standard in America, the *Life Insurance Primer*, by Henry Moir.

The material is presented in a very interesting manner and is rather comprehensive in that it gives the elements of various phases of actuarial science that might not be expected, such as increasing insurance, select mortality tables, various methods of calculating reserve tables, and various alternative formulas which bring out the real meaning of different functions and their relationship. One is a little surprised to find even a chapter on gross premiums. If any criticism might be offered of the book it might be at the amount of space devoted to the subject of modified preliminary term valuation. On the other hand, this subject had never been comprehensively treated, and the authors' methods are new and illuminating and would have been very valuable even for actuaries if Mr. Menge had not subsequently further elaborated the subject in a paper "Preliminary Term Valuation Methods" in Volume XXV of *The Record* of the American Institute of Actuaries. A valuable feature is the unusually good sets of problems throughout the book. Sufficient actuarial tables are given to enable the student to solve the problems.

JAMES S. ELSTON

The Travelers Insurance Company

A First Course in Educational Statistics, by Edna E. Kramer. New York: John Wiley & Sons, Inc. 1935. ix, 212 pp. $2.50.

In the preface of this book the author has stated the following as her objectives: "(1) to present in elementary fashion those statistical facts which

form a necessary background for a proper understanding of educational literature and a minimum prerequisite for educational research. . . . (2) to reduce the mathematics involved to simplest form. . . . (3) to stress the practical rather than the theoretic aspects of the subject." The objectives seem to be appropriate for a book having this title.

All the topics expected in a first course in educational statistics are found in the book. Beginning with elementary statistical procedures, which include directions for grouping data and the making of frequency tables, the treatment passes on to averages, measures of variability, graphs, frequency curves and the Normal Probability Curve, reliability of measures, and correlation. The last named is presented in two chapters. The development of the idea of correlation and of curve fitting is presented first. The next chapter is devoted primarily to applications of correlation. In an appendix is found a list of formulas appearing in the text and a derivation of several of them. This appears especially commendable.

Each topic is introduced by illustrations of its use. This serves not only for motivation but also to promote a more intelligent approach to the topic. The value of the book is enhanced also by closing each topic with a summary.

There are numerous exercises in the book. In some introductory texts in statistics the exercises are nearly exclusively computational in character. This book presents many whose primary purpose is to promote interpretation.

Each topic appears to have been developed with the learner constantly in mind. The step-by-step development is carefully done. The approximate mean, for example, is reached in five distinct steps and fills seven pages. In some topics diagrams are used to make clear what lies behind the computations. An example of this appears in the topic on the median.

Students taking this course vary greatly in mathematical ability and in the amount and recency of their mathematical training. This fact is recognized by the author when she presents detailed explanation and illustration of the use of tables of squares and square roots. Many students who have only a hazy notion of interpolation will gain a clear idea of it here. How to use the table of area under the normal curve is also treated in the same clear way.

The symbols and formulae used in the book are those which appear most frequently in educational literature. No typographical errors were noted.

Throughout the book the author appears to have kept her objectives in mind and to have attained those objectives to a marked degree. The result is an excellent textbook for a first course in educational statistics.

ROBERT V. YOUNG

University of Pittsburgh

Contribution a l'étude des fortunes privées d'après les déclarations de succession, by E. S. Danysz. Paris: Berger-Levrault, 1935. 34 pp.

This study, leading to an estimate of the wealth—strictly, of the property in private hands—in France about 1931, is of chief interest to economic

statisticians for its development of method and its elaboration of certain significant facts about wealth distribution according to age and sex. The estimate itself yields, for all France, a figure of the order of 575 milliards of francs, of which somewhat over 100 milliards is assigned to inhabitants of Paris.

The practice of estimating total property of a living population from statistics of legacies is fairly old and may be said to reach to all times and places for which an inheritance tax or its equivalent creates such statistics. The crude process of estimating consists in multiplying the annual amount of property passed through inheritance by a factor representing roughly the average period between two passings of the same property. This factor is evidently, in a special sense, the average length of a generation.

Critics have long insisted upon certain defects in this process, chief of which is the implicit assumption that the property holdings of a group of individuals at death form a good sample of the property holdings of the entire living population. Such assumption is obviously unwarranted, mainly because the age distribution of decedents differs from that of the living whereas amount of property is correlated with age. Also, and especially in a country where custom or law acts in that direction, sex distorts the sample for this estimating scheme; and other characteristics of the population may play a minor part in damaging the validity of the sample automatically produced by death.

The essence of the Danysz method—as he notes, it is the application of a method long ago suggested as appropriate whenever data in the necessary form should become available—is to treat each group of decedents, according to age and sex, as a sample of the living in that age and sex group. On this basis, the passage from the amount of property inherited in a given year to an estimate of total property of the living is a problem in weighted averages (or aggregates):

$$F = \sum \frac{V_{as}}{D_{as}} F_{as}$$

where F is total estimated wealth, V_{as} and D_{as} are respectively number of living and number of decedents in a given age and sex group, F_{as} is the aggregate wealth held by the decedents in such group, and summation covers all groups.[1] Here the sampling assumption manifestly consists in taking the average holdings of the living members of the particular age and sex group as equal to the average for the decedents (F_{as}/D_{as}) in that group, a broadly tenable assumption.

By examination of the algebraic properties of C, the author finds that: (1) C varies inversely with average mortality of the entire population; (2) C is independent of differences, between times and places, in the general level of wealth; and (3) C depends upon the degree of correlation between

[1] I have not followed strictly the author's notation (his page 12), nor his algebraic formulation which is in terms of his coefficient C, the factor (mentioned above) representing average period between two passings of the same property.

amount of property and mortality at specific age (the same applies also to sex, apparently).

The bulk of the memoir reports the application of this weighted-average method to a limited body of data recently made available in France, in response to a resolution passed in 1909 by the Société de Statistique de Paris. Satisfactory examination of the memoir will be facilitated by a study of the earlier and related paper by the author, in which he discusses characteristics of the data in greater detail, presents tabular materials much more fully, and develops notable supplementary facts about the distribution of property.[2]

The present memoir contains, however, a helpful description of the data, with pertinent remarks about French customs and legal and administrative considerations; and there are significant comments on the trustworthiness of the data, with some reference to the question—ever-present in cases where statistics are generated by taxation—of evasion. A perplexing difficulty, which receives much attention, is the timing of the deaths, in relation to timing of corresponding tax reports. The data are not all-inclusive for France: they relate to Paris and to the one department, la Manche, which—on somewhat sketchy argument—is taken as a sample of France outside of Paris.

The main findings are emphatic: there is a definite correlation between size of fortune and age; the distribution is sharply different for men and for women, and for Paris and la Manche. Average fortune increases with age, throughout the range of age for Paris, and until middle life for la Manche. General average fortune, without regard to age, is higher for women than for men, both in Paris and in la Manche; but in the higher age groups, specific average fortune runs lower for women than for men.

With this evidence of association between size of fortune and age (and also sex) before us, there can be no doubt of the force of the author's main contention: that C is not a simple and constant factor but is a weighted index dependent upon economic, social, legal, and other demographic characteristics of a particular community at a particular time.

An American statistician may well inquire whether this method can be used in estimating total private property in the United States. Some significant evidence on the correlation of private fortune with age and other factors is afforded by portions of the record of Federal estate-tax statistics.[3] Unfortunately, the Federal tax has such a high exemption limit that these statistics do not enable us to carry out the Danysz analysis. If the Federal data were systematically tabulated (detailed breakdowns are no longer published) according to sex and age, much progress could be made in studying the property distribution for groups above those of very moderate means; but the mass of small holdings would be missed. This deficiency cor-

[2] "Contribution a l'étude des fortunes privées," *Bulletin de la Statistique Générale de la France*, XXIV, Oct.–Dec., 1934, pp. 111–171.

[3] I have discussed these data, and their limitations, in "The Distribution of Wealth," Business Research Studies 13, Boston, Harvard Business School, October, 1935.

responds to a similar gap in our data on individual incomes: American tax statistics cover directly only the incomes of the small fraction receiving somewhat more than day wages. Without discouraging the removal of the deficiency in the estate-tax data—perhaps by studying state and local records of small inheritances—and without denying the desirability of a more detailed tabulation of Federal estate-tax returns, we may fairly urge that the American economist prefers a more extensive and precise measurement of small *incomes*. All this is said in the light of practical needs of the American case—the method, analysis, and findings of Mr. Danysz are heartily commended.

W. L. CRUM

Harvard University

The Distribution of Wealth: A Factual Survey Based upon Federal Estate-Tax Returns, by William Leonard Crum. Boston: Bureau of Business Research, Graduate School of Business Administration, Harvard University. Business Research Studies No. 13. Vol. XXII, No. 7. 1935. iii, 24 pp. 50 cents.

Professor Crum's latest contribution to the analysis of governmental financial materials constitutes a careful study of estate-tax statistics. The data, available from 1916 on, are subjected to scrutiny by plotting curves of the Pareto type. With the cumulative number of net taxable estates as ordinates and their size as abscissae, the resultant curve is quite smooth but possesses "an unmistakable curvature with upward convexity." If, however, the size of estate is adjusted to include the specific $100,000 taxable exemption, then the curve becomes much more nearly straight (both scales, of course, are logarithmic). When a straight line is put through two points of this second curve, the reciprocal of its slope (for the year 1930, 0.806) furnishes a measure of "average inequality." Measured over time, average inequality shows something of a cyclical movement since 1922, culminating in a sharp decline in 1932–33.

Further analyses discuss size variations of estates in relation to the age of the deceased persons, their sex, and the composition of the estates' holdings of various types of investments during the 1922–33 period.

The significance of many of the findings is limited by the fact that the sample is severely truncated, i.e., it necessarily includes only estates of as much as $100,000 (in some years, $50,000). Professor Crum is careful, however, to point out this and other limitations; and, as in his previous efforts, he has utilized the available data to their fullest legitimate extent. The study is thus a fine start in the field of estate analysis. If it could ever be followed by sample analyses of surrogate court records for smaller estates, and the two sets of materials then linked to show facts concerning the degree of concentration of wealth, we might learn much of interest to both advocates and critics of the various "Share-the-Wealth" philosophies.

RALPH C. EPSTEIN

The University of Buffalo

Stabilized Accounting, by Henry W. Sweeney. New York and London: Harper & Brothers. 1936. xiii, 219 pp. $3.00.

This book comprises two main things, a discussion of the problem of fluctuating values arising from changing price levels, and an accounting device by which correction may be made for these fluctuations. The former is likely to attract more attention, and to have much more far-reaching effects, than the particular method proposed for dealing with it. A number of examples are given to explain how the stabilized amounts will be computed and applied.

The central question provoked by this book is, of course, whether any such procedure will really add to the value of what the author terms "ordinary accounting" or "orthodox accounting." His first chapter, entitled "Where Ordinary Accounting Always Goes Wrong," strikes the keynote of the book and seeks to prepare the mind for his remedy. The difficulties he there points out are very real, and every man of experience in this field has been troubled by them. In casting about for ways in which to deal with this problem of changing values, accountants are likely to receive considerable stimulus and suggestion from this book, though they may not make much use of the author's specific recommendations.

The discussions throughout imply certain fundamental differences in viewpoint between the author and the "orthodox" accountants, and it is in these differences of viewpoint that the nub of the question lies. The first is that which leads him to adopt a predominantly mathematical conception of accounts. He complains (p. 42) that the balance sheet "violates the fundamental mathematical rule that like must be added to like." His plans require (p. 176) that "the total amount of theoretically correct depreciation that should have been provided on the books must be calculated." He aims at a "basis whereby final accomplishment is judged" rather than merely looking at "current accomplishment." This attitude is another example of the tendency which has been described as looking for certainty where no certainty exists, and there is the real difficulty with the entire program of stabilization. After all Mr. Sweeney's corrections, a balance sheet and income statement would still contain many variables subject to sound judgment; and the very insistence upon mathematical exactitude would tend to divert attention from these essential questions of judgment and thus mislead in the interpretation. For although accounting is quantitative in its expression, its interpretation must become essentially qualitative before it can be said to have reached a very penetrating level.

The plant account may be taken as an example. The author's method would result in showing the plant in the balance sheet at a replacement cost, that is, assuming it were stabilized at *current* price levels, a question which Mr. Sweeney leaves somewhat open. But is replacement cost nearer to a true value than the orthodox original cost? The true value of the property is really conditioned by the ability of the management which operates it. If the earning power is high, its true value may equal the replacement cost, or even exceed it; if the company goes bankrupt, the true value will

be in the neighborhood of junk prices. The author speaks of economic considerations; in the case of plant value, earnings and the ability of management which they reflect are the determining economic considerations.

It would be interesting to have Mr. Sweeney deal somewhat more definitely with the question of the price level at which he recommends stabilization, perhaps different levels for different purposes. On pages 109–110, he computes the inventories of a woolen mill, stabilized first on a base-year, and second on current price levels. In the subsequent balance sheet he chooses the latter; his stabilized inventories are then higher than the unstabilized, because prices have increased during the year—a result which is in conflict with the rule of the lower of cost or market. Elsewhere (p. 109) he takes cognizance of this rule and makes the base-year the point of stabilization. This particular piece of stabilizing approaches, in method and substance, the normal inventory method practised by a number of companies, and for which there is a good deal to be said.

The property accounts and the inventories are the accounts in which price fluctuations create most difficulty, and probably the difficulties are not removed by stabilization. When the author regrets that the ordinary balance sheet adds together "cabbages, carrots, and little red radishes" (p. 8), his distress is well founded; but after he gets through with his stabilization the cabbages, carrots, and little red radishes are still there, with a few pumpkins thrown in. Plant assets, inventories, and receivables really are very divergent assets; the art of accounting interpretation requires an understanding of these divergencies, and mathematical contrivances to eliminate them do not assist.

A number of corporations give, in their annual reports, information about price levels and unit prices relating to their inventories; less often they give information about present replacement values of their plant. In many cases it would be helpful if more information of this sort might be given, especially with respect to inventories; and, if this turned out to be one of the results of Mr. Sweeney's book, it will have eminently justified its appearance. But for purposes of the accounts original cost is probably still the most significant fact about the plant.

T. H. SANDERS

Harvard Graduate School of Business Administration

Twenty-Five Years of Accounting Responsibility, 1911–1936, by George Oliver May. Essays and Discussions, edited by Bishop Carleton Hunt. New York: American Institute Publishing Company, Inc. 1936. Two volumes with independent paging, totaling 778 pp., under one cover. $3.00.

A professional man has a number of responsibilities which do not attach to a business man—at least not in the same degree nor to the same extent.

The primary responsibility of each is that of succeeding in his chosen fields of work. Beyond that, however, the professional man has some obligations to his profession. He must so act in his own practice that the standards of professional practice are maintained and extended; he must not by his own practice bring his profession into disrepute. Further than that, he must be willing to take part in those activities which will bring among all practitioners an acceptance of the ethical standards of the profession and he must be willing to ally himself with others of his profession for the purpose of strengthening it and of extending its useful service to business and society. This responsibility is usually met by membership in professional societies, by service on their technical committees, and by acts of general service to his community, state, and nation.

The members of a profession must recognize also the duty of contribution to the substantial literature of the profession. Without this, much of professional experience arising out of the problems of practice would be lost to posterity. I do not mean to say that all contributions to the current literature of the profession are of substantial value, nor do I imply that the record of the solution of the current problems of practice will, *ipso facto*, provide the solution of the problems of future practice; problems of practice are never met twice in exactly the same setting. In a profession—as distinguished from a trade or craft—the element of human judgment is always present; it is the outstanding characteristic of a profession. The exercise of judgment can never be reduced to the pat application of rules of thumb.

Whether consciously or not, Mr. George O. May, the author of these two volumes of collected papers published under the title, *Twenty-Five Years of Accounting Responsibility 1911–1936*, very definitely evidences recognition of his responsibility to his profession. I am inclined to think that this recognition on his part is one of the things that mark him over the years as one of the leaders of his profession. The growth of a profession is never attributable to one individual, but the reader of these volumes must acknowledge that the author has been at the front in every worthy effort of the profession, always ready to work with his fellows for the advancement of his profession.

This collection of papers, written over the period 1912–1936, is a fine record of contribution to the substantial and timely literature of the profession, and it was a particularly happy and gracious act on the part of his partners to collect them and present them to Mr. May on the twenty-fifth anniversary of his leadership of the firm of Price, Waterhouse & Company. In this short review, I shall not attempt a critical appraisal of them, but I do want to point out the breadth of Mr. May's interest by indicating their extent. The two volumes comprise some 778 pages of material, divided into seven parts, as follows:

Part I, of thirteen chapters devoted to various aspects of the Profession of Accounting

Part II, of seven chapters covering the topic Depreciation

Part III, of ten chapters treating of some of the problems of Valuation

Part IV, of ten chapters devoted to the Regulation of Securities, chiefly as related to the practice of accountancy but with considerable attention to the political aspects

Part V, of sixteen chapters, of which eleven treat of Taxation in general and five of some phases of Taxation and Accounting

Part VI, of three chapters devoted to a consideration of the Influence of Accounting on the Development of an Economy

Part VII, of seven chapters covering Reviews and Criticisms

The editor, Mr. B. C. Hunt, on whom fell the task of selection, organization, and arrangement, is to be congratulated on a well-balanced volume.

These two volumes will find a place in every professional accountant's library and are worthy of a "seat of honor" in every collection treating of the different professions.

ROY B. KESTER

Columbia University

The Development of the Business Corporation in England 1800–1867, by Bishop Carleton Hunt. Cambridge, Massachusetts: Harvard University Press. Harvard Economic Studies, Volume LII. 1936. xii, 182 pp. $2.50.

Mr. Hunt's personal belief is reflected in his remark about Parliament's placing the corporate form under lock and key after the South Sea Bubble burst, when, as he says, "Circumstances, it would seem, called loudly for legislation which would, while facilitating incorporation, provide safeguards against fraud in promotion and management." His thesis is that it required a struggle of two centuries to bring about in England the recognition of a place for the limited liability company, the thing we know as a corporation, as an ordinary instrument for private enterprise. He depicts this struggle in details that he draws with equal ease from newspaper files, parliamentary debates, economic pamphlets. His bibliography is a joy to behold, and his use of it masterly. But in this mass of detail he never loses sight of the struggle for emergence of an idea—the need for the limited liability company. This idea itself is controversial. Not only does Mr. Hunt quote *The Times* against it seventy-five years ago, but at the end of his book he comes upon the discovery that Professor Heckscher in our own day again minimizes the importance of limited liability. The truth perhaps lies in the middle. The principle of limited liability carries with it obvious evils that have been emphasized from time to time and that have turned men against it as a contributory cause of depressions. On the other hand, in England as well as in America it has facilitated the accumulation of capital for private enterprise on a scale hitherto unparalleled in history.

The wisdom of keeping in sight the evolution of the idea of the modern corporation through the maze of minor details, personalities, accidents, and incidents in its history is readily suggested when we realize that American business law through an entirely different series of details has in approximately the same period reached the same goal. Beginning in 1800 with a

corporation law that was dependent on specific acts of incorporation by legislatures, granted only to public or semi-public enterprises, we reached at the end of the Civil War a period in which incorporation was accomplished by general statutes and open to every variety of business. There remain, however, certain differences which may be traceable in part to the divergent histories, but in a greater measure no doubt to the different needs, of the two countries. It is striking, for example, that the joint stock company was able to organize itself as a huge partnership with transferable shares and concentration of powers though not endowed with limited liability in this country, but that it never became one of the important modes for the bringing together of capital in competition with our easily organized corporations, on the one side, and our various types of statutory limited partnership, on the other. It is striking, too, that the limited partnership was made possible in one state after the other in this country a half century before it was adopted in England. The explanation may be that there were relatively larger fortunes available in the hands of small groups for the carrying on of the big business of England at that at the same time there was no economic necessity for large-scale operations of the kind that developed in America in the last quarter of the nineteenth century. Another contributing factor may have been competition among our states which resulted in very lax and easy corporation laws, such as some of the states resisted and probably would have resisted more successfully had they been in a position of isolation comparable to that of England. Mr. Hunt is not concerned with any direct comparison with America or the lessons that the English experience has for us, and yet there are passages, including quotations neatly selected from contemporary sources, that are strikingly suggestive of current conditions and comment throughout the book. In the days of the South Sea Bubble there were those who found in the joint stock system "the sole and sufficient explanation of the miseries of the country," and the act passed reflected more anger than deliberation. A century later, England was enjoying a boom, described in the King's speech: "There never was a period in the history of this world when all the great interests of the nation were at the same time in so thriving a condition" (p. 37). The record continues: "Most of the promotions were to perish in the crisis which followed the exuberant prosperity of 1824–25." There were, in fact, several "manias" of promotion, each followed by a day of reckoning, and in each case belated parliamentary action was the result—but not until 1867 did Parliament seem quite willing to go to what our author considers the root of the matter by making the organization of limited liability companies a privilege to be recognized as of common right. With this achievement the book ends. That human nature was not changed, and that stock gambling, booms, and depressions have recurred since, is a theme for another study.

NATHAN ISAACS

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The Decline of Competition, by Arthur Robert Burns. New York: McGraw Hill Book Company, Inc. 1936. xiv, 619 pp. $5.00.

The Modern Economy in Action, by Caroline F. Ware and Gardiner C. Means. New York: Harcourt, Brace and Company. 1936. xi, 244 pp. $1.60.

These two books, although quite different in style and scope, have a considerable similarity in theoretical background and conclusions. Both are closely related to the idea, recently emphasized in certain theoretical studies, that much of the competition that occurs in our society is the competition of monopolists. With this as their point of departure from the conventional economic analysis, the authors proceed to a more realistic consideration of business practises and problems of economic policy than has been provided by the theoretical literature on monopolistic competition. The difference between the attitude on questions of social control resulting from the newer and less widely accepted doctrine and that promoted by the conventional theoretical orientation is brought into bold relief in these volumes. Their main theme is that the failure of competition to yield satisfactory results is neither limited to a few industries affected with the public interest nor to situations resulting from the predatory propensities of a few individuals, and that the measures of social control required are far more extensive than those for which any excuse can be found in the more usual neo-classical economics. The authors have thus undertaken to demonstrate the need for a broad control of industry in the light of the general interest. Neither book, however, leads simply to a plea for an all-controlling government. The discussions of problems of social control are characterized by concern that the control contended for should be accomplished within the framework of political democracy, with a minimum of coercion and with a maximum of decentralization.

In the introduction to his book, Professor Burns discusses the failure of competition to function, under present conditions, as the classical economists expected. He attributes this failure principally to developments in industrial technique during the past half century, but also in some measure to corporation and patent laws. He believes that no anti-monopoly legislation which has been enacted or proposed can compel business to operate according to competitive formulae. In his opinion, competitive processes, as explained by nineteenth century economic theory, have been undermined by more fundamental phenomena than combinations in restraint of trade and the elimination of rivals through "unfair" competitive practises. In fact, he suggests that the trust movement itself was the result of the prior appearance of monopolistic elements in many industries accompanying the decline in the numbers of directly competing firms. The literature dealing with trusts and pools, Professor Burns contends, has been too much concerned with the application of naïve tests of competition and monopoly to throw

much light on the consequences of the practices of business enterprises whose situations conform with neither the ordinary conception of monopoly nor the economists' conception of competition. The theory of "imperfect" or "monopolistic" competition, he thinks, has provided a more fruitful approach to the study of business practises.

The body of Professor Burns' book provides an elaborate and documented survey and analysis of market and production policies and inter-firm relations in several industries. Trade associations, price leadership, the sharing of markets through agreement or fear of reprisals, the stabilization of individual prices, price discrimination, non-price competition, and the integration of industrial operations are all subjected to penetrating examination. The book provides the best analysis of commercial policies that has come to the reviewer's attention.

It does not appear, however, that Professor Burns, in his analysis of commercial practises, has been able to make much use of the more refined parts of the theory of monopolistic competition. The realities of the situations in which business policies are formulated are incapable of being expressed in terms of an elaborate geometry. It is not, therefore, in any precise and finely drawn conclusions regarding the practises of business enterprises in various situations, but rather in marshalling the material in support of the general thesis, that the book has its chief importance and distinction. The characteristic policies of business are shown to result from situations which however different in details are alike in that they render inappropriate the conclusions of conventional economics regarding the results to be expected from unregulated enterprise.

The tenor of Professor Burns work is well illustrated in the chapter on industrial policies under the National Industrial Recovery Act. His appraisal of the procedure and activities of the Government under that act is unfavorable. The codes, he points out, operated to increase the concentration of control in each industry and the administration's policy "was directed to considerations no more fundamental than an estimate of what the representatives of industry would accept without protest." His discussion of this experience, however, is tempered by the conviction that the market and production policies followed under the Act were not as different from those ordinarily pursued by business organizations as conservative criticism of the Act implies. "The abandonment of the National Industrial Recovery Act," he says, "provided no solution to the problem of adapting economic institutions to an industrial system diverging increasingly from free competition. . . . The state cannot by refraining from positive control obtain the benefits of free competition. On the other hand, state participation in price policies presents profound and complex problems both economic and political. Yet some such participation is inevitable."

The final two chapters of Professor Burns' book are devoted to discussions of the general objectives of social control and the means by which these ob-

jectives may be attained. He describes the objectives in abstract and general terms and has not attempted to indicate their practical application.

The Ware-Means book is a less formidable volume. It is somewhat in the style of pamphlet literature and intended to appeal to a wide audience. Its purpose is to contribute to the formation of a new "climate of opinion" in replacement of that predisposition in favor of *laissez faire* which early nineteenth century economics promoted, and which later economics in the classical tradition has continued in the main to sustain. The authors feel that what is needed to develop sound popular thought on present social problems is not chiefly additional factual information but reconsideration of the underlying assumptions on which current "common sense" attitudes are based. The facts of every day observation, they contend, are patently out of conformity with the views of affairs which most people entertain; yet these views persist simply because their basis is seldom questioned. The book contains little factual information that is not common knowledge. The argument itself is reduced to its absolute essentials. Sixty-two small pages suffice to explain why the ideas at the basis of the prevailing habits of thought were reasonably appropriate in the "old economy" but are ridiculous in the "new." The displacement of flexible competitive prices by administered monopolistic ones in a large segment of industry is, of course, what makes the difference. More emphasis is laid, however, than in the Burns book on the effects of the changed conditions on the working of the system as a whole—the tendency of disturbances to cause increasingly severe maladjustments.

After thus preparing the reader, Miss Ware and Mr. Means proceed into a brief survey of the whole run of problems of the relations of government to industry and business. In this survey, the authors employ several lines of analysis that have been presented with much greater elaboration in other treatises. Though such parts of the argument are much simplified for the purpose of maintaining the interest of the general reader, it appears to the reviewer that the book deserves the attention of professional economists. Some of the elements of the analysis are more convincing when definitely integrated with the authors' price analysis than when they are regarded as refinements or additions to the strictly classical economics.

Many questions regarding the remedial measures proposed by Miss Ware and Mr. Means are not answered in the book, as they are well aware; but in the reviewer's opinion, they have made a persuasive and readable contribution toward the creation of the "climate of opinion" in which problems of social policy need to be considered.

L. A. MORRISON

United States Tariff Commission

The Economics of Open Price Systems, by Leverett S. Lyon and Victor Abramson. The Brookings Institution, Washington, D. C. 1936. xii, 165 pp. $1.25.

The Brookings Institution has added another to the posthumous offspring of the National Industrial Recovery Act, already both remarkably numerous and promising. The present study traces the development of the cooperative collection and dissemination of information concerning prices in the markets for manufactured goods and analyses its effect on prices and production, on the small firm and on industrial integration. The authors set out the criteria of social usefulness in open price systems and discuss the industrial situations to which they are appropriate and the proper policy of social control. The discussion is admirably lucid and orderly, yet it falls short of one of its stated objectives, viz., to offer constructive aid to business men and government officials.

The problem is to design the most suitable environment for the price making process. Drastic changes in conditions of manufacturing and marketing during the past hundred years have compelled business men to adapt their market behavior, and the reconsideration of public policy is an urgent necessity. In three and a half tenuous concluding pages on this subject the authors come very near to the reported instruction of a public official on a difficult and important matter of public policy, viz., "let the appropriate officer take the appropriate action." Aside from comments upon administrative techniques they remark that open price systems would be differently devised according as they are intended to facilitate "informed competition" or further a system of state cartels; they call, therefore, for a clear declaration of public policy concerning unfair competition by the appropriate legislative and judicial bodies. But the remainder of the study is infused with a preference for the facilitation of "informed competition" and with a belief in the possibility of the restoration of a competitive individualism that will result in the best use of economic resources after the manner outlined in their preliminary exposition of the operation of such a system. Accordingly, they judge the social desirability of various types of open price system in terms of their capacity to induce this "informed competition."

Ignorance and misinformation obviously exist in many markets, and open price systems could diminish these sources of irrational operation. But they may go further. The authors point to their capacity to induce or facilitate price agreements and stimulate forms of indirect pricing. Refusal of permission to establish open price systems would not, of course, restore competition in such markets, but its universal establishment is not the present problem of the authors. They point also to the possibility that such systems will reduce to vanishing point the interval of time in which firms can attract business from rivals by price reductions. But they contend that secret price cutting involves discrimination and breeds bad feeling. More fundamentally, they conclude, it is objectionable because it may result in an ill informed and unwise allocation of resources. But it should also be emphasized that

knowledge reduces the downward pressures upon prices and also thereby affects the allocation of resources. It is questionable whether the criterion of the smoothly operating market lubricated by information yields any adequate general basis for the establishment of the most desirable environment for price making.

The solution to this problem in particular markets involves a knowledge of conditions in the market because, as the authors emphasise, systems vary in their manner of operation from one industrial situation to another. But research into the operation of particular systems is an indispensable prelude to even general guidance to business men and public officials. The present work relies upon the few studies already made and tends, therefore, to a marshalling of possible relations of cause and effect without adequate appraisal of their relative significance. An investigation of the actual operation of such systems seems peculiarly appropriate to a research institution, and it is to be hoped that the Brookings Institution will use the present work as the ground plan for such an investigation.

ARTHUR ROBERT BURNS

Columbia University

Minimum Prices under the NRA, by Herbert F. Taggart. Michigan Business Studies, Volume VII, Number 3. 1936. viii, 307 pp. $2.00.

As chief of the Cost Unit of the Research and Planning Division of the NRA for a considerable period, Professor Taggart was required to play an active part in the efforts of that agency to establish minimum prices and minimum prices bases. It is particularly interesting, therefore, to have his report on the subject of minimum prices under the NRA.

The book consists of eleven chapters. Two are introductory; one deals with legal and administrative matters; one is a final appraisal; and seven are concerned with specific bases for or forms of minimum prices. The titles of these seven chapters well state the categories into which minimum prices under the NRA may be placed. They are: Bases for Minimum Prices: Average Cost; Bases for Minimum Prices: Lowest Cost; Bases for Minimum Prices: Individual Cost; Bases for Minimum Prices: Other Cost Bases; Minimum Prices not Specifically Based on Cost; Loss Limitation; Emergency Minimum Prices. These chapters necessarily constitute the body of the volume and that segment of material with which Professor Taggart may be supposed, both by professional training and NRA experience, to be highly qualified to deal.

Although in such a study from an acountant, one naturally looks for and regrets the absence of a survey of the problems involved in the establishment of uniform cost accounting methods in connection with NRA minimum price fixing, this is deliberately excluded, the author explaining that it will be published in a separate volume. Each chapter is in the nature of a general running account, including an explanation of the type of minimum price

fixing under discussion, in some instances an explanation of exceptions which were permitted, a series of illustrations of applications to various industries, intermixed with comments by the author, and arguments for and against this particular type of price-fixing as expressed by those in authority within the NRA and by proponents and opponents inside and outside of the organization. There is also in most instances some appraisal of administrative effectiveness.

In discussing lowest cost as a base, for example, the author cites the first use of this standard (in the code for the millinery and dress trimming braid and textile industry, approved October 31, 1933) and sets forth the language in which duties under this standard were imposed upon the code authority. This agency was required to "compute the lowest reasonable cost of production of products in the industry, which shall be determined as follows: It shall, from time to time, but not less than once each year, through certified public accountants, approved by the Administrator, compute the lowest reasonable cost of production on a fair basis. When this lowest reasonable cost has been approved by the Administrator, it shall be proclaimed by the Code Authority and shall be binding upon all members of the industry."

But the code, says the author, "set up no definition of 'lowest reasonable cost,' and no standards by which it might be known." The intention, he continues, "was to formulate a list of minimum prices, and the phrase was probably invented in an effort to make the scheme appear harmless." The interpretative vicissitudes to which this phrase was then subjected inside and out of the NRA are recited. The secretary of one code authority is reported as having hailed it as giving "to all industries the right to fix prices on the same basis granted to the lumber industry," and expressed his opinion that the "new policy" opened up "new vistas of profit for industry."

The introduction of this standard into other codes led to added interpretations and added problems. It was adopted as the minimum price basis for "emergency purposes" in nearly one hundred codes and supplements. The chief difficulty in its administration, says the author, "lay in the fact that the provisions must be put into effect on the basis of cost data gathered and presented for approval." This, he declares, is "an almost hopeless task in the many industries in which uniform . . . cost accounting methods are practically unheard of." "The Administration," he observes, "was wise when, in formulating the emergency price basis for Office Memorandum 228, it abandoned the expression 'lowest reasonable cost.' "

Similarly is traced the NRA's experience with the other forms of minimum price base and minimum prices. In a general statement the author observes, "Broadly speaking, the attempts at setting minimum prices failed. They not only disregarded fundamental economic doctrines, but they were so subversive of the entire philosophy of anti-monopoly legislation that it was impossible to secure their legal enforcement. They lacked the unanimous support of the members of industry whem they were supposed to help and, as might have been anticipated, failed to obtain the favor of consumers."

On the basis of his own presentation of data it would seem that he might well have added, "and perhaps most of all on the grounds of the impracticability of determining a real meaning for the standards declared."

Of the four more general chapters of the book, that entitled Legal and Administrative Background and Cases under the NRA seems to the reviewer the most effective. I find some question regarding a number of points in other chapters. For example, the author opens with the statement, "The NRA was foreordained to failure." He points out "that accomplishments were arrived at through bargaining" and concludes, "It was through this procedure that the NRA became a measure both of recovery and of reform and thus dissipated its energies by attempting to cover far too much ground too quickly."

It seems to me a more accurate view that it was the Recovery Act itself which embodied both recovery and reform. It was the law which seems to me to have compelled the type of procedure which was followed. Indeed, the President declared that the law was concerned alike with getting "many hundreds of thousands of the unemployed back on the payrolls." and with planning "for a better future for the longer pull."

More significant, however, were the procedural provisions of the law. Either mandatory or "voluntary" codes were possible. When the choice was made in favor of voluntary codes, the bargaining procedure with all that it entailed became inevitable. It was industrial groups which were authorized to come forward and to volunteer codes of fair competition. (Section 3(a) of NIRA.) It is obvious that such groups would, typically—particularly in view of the modification of the anti-trust laws embodied in the NIRA—present proposals for their own benefit rather than those directly concerned with increasing employment and wages and reducing hours. To secure in *voluntary* codes provisions of the latter type, believed by the Administrator to be essential to recovery, a bargaining procedure was imperative. Once the decision was made to use voluntary codes, there was for the Administrator no alternative to a bargaining procedure.

In a final chapter dealing with appraisal and critique of minimum price fixing, the author has employed, I think, an admirable technique in setting out and commenting upon a series, first of economic assumptions, and then of practical assumptions which underlay minimum price fixing in the NRA. Most of both he believes unsound, or at best questionable. In some of these I find that I should prefer a somewhat different statement—perhaps a different analysis. For example, page 242, "Economic Assumption No. 1: That unsatisfactory price phenomena are industrial ills of themselves, rather than mere symptoms. The actual ailments of industry were, at the time the NIRA was enacted, and still are too fundamental to be cured by a mere attack on price. Industry was suffering, first and foremost, from a severe and prolonged depression. Artificial stimulation of prices would, if anything, prolong and intensify this disease." Such a statement is gratifying (excepting that the phrase "unsatisfactory price phenomena" leaves one wondering, unsatisfactory to whom). But the next sentence reads, "More fundamentally, industry

is afflicted by the tremendous incerase in capacity created by technological advances. . . . " In view of many other statements in the book, it seems that Professor Taggart seriously shifts his points of reference, when he suggests that our increased capacity and technological advances are industrial afflictions.

A somewhat similar example is to be found in "Economic Assumption No. 2" (page 242) which reads "That every business is entitled to a profit. It would be closer to the truth to say that a business is entitled to a profit only when it earns a profit." Why say it is *closer* to the truth, rather than the truth? The paragraph concludes with the sentence, "However, if all businesses were entitled to a profit, and such a rule were to be enforced, a good deal of economic motivation would be lost." This seems a rather feeble summary of the issue at stake.

These illustrations perhaps serve to indicate the characteristics which make the four more general chapters less satisfactory then those which deal directly with what may be called the "inside stuff" growing out of the author's close experience with the NRA.

Professor Taggart's general style and method are very refreshing. He explains early that he "has drawn freely on notes and memoranda made during his connection with the NRA." This fact adds to the book's contribution to the record of the Recovery Administration. With comment on those both inside and outside the NRA and with the quotations from them, he lays about him with that freedom which is conventionally designated as calling a spade by its real name. He cites a pronouncement of the National Industrial Recovery Board (this was after the resignation of General Johnson) as "an excellent example of the ineptitude of many of the public announcements by the Administration." He says, "Read carefully, the statement is very fuzzy. Its meaning is vague" (page 45). He even conjectures on what the NRA might have been with what he calls a "stiffer spined Administrator."

LEVERETT S. LYON

The Brookings Institution

British International Gold Movements and Banking Policy. 1881–1913, by W. Edwards Beach. Cambridge, Massachusetts: Harvard University Press. Harvard Economic Studies, Volume 48. 1935. xiv, 211 pp. $2.50.

The contribution of this scholarly study consists in the presentation of valuable material, statistical and descriptive, concerning a somewhat neglected epoch of English monetary history. Two chapters deal with the statistical data proper, presenting them as series, preferably with trends eliminated, of external and internal gold flows; of bullion and notes in the Bank's figures; cash holdings and balances of the commercial banks; money rates; index numbers of the general price level, and other cyclical indices. The series are based mostly on critical analysis of the sources and provide

excellent raw material for future studies. In the present study, however, they do not seem to serve for much more than to demonstrate that during the upturn, in England as in America, the central market tends to gain gold from the outside and to lose gold to the interior, whereas the flow tends to be reversed in the depression (pp. 38–104). Exceptions, such as the heavy gold imports in the stagnation period between 1893–94 (p. 127) are not accounted for. More insight is displayed in the descriptive chapters (pp. 105–151) with their rich material on the history of the London money market during the period under review. They amount to a very instructive analysis of money market cycles and of the Bank's policies to cope with them, with emphasis on the gold movements. Many details disclosed by this painstaking piece of research are highly relevant to diverse aspects of present-day monetary discussion.

The difficulty in appraising the study as a whole arises, however, when one attempts to corroborate its empirical approach with its theoretical pretensions. The none-too-clear theoretical Chapter II (pp. 7–37) insists on the necessity of using factual data to determine the relevance of cyclical fluctuations to the mechanism which adjusts international balances. But the issue seems to narrow down, as the study proceeds, to that raised in the "introduction" (pp. 3–6), of the relative importance of discount rates and capital movements as compared with commodity prices in bringing about the movement of specie. The conclusion of the author is of course that the former is far more important than the latter; but this is hardly a new contribution. Nor is it sufficiently elaborated, lacking proper analysis of such distinctions as between short-run and longer-run processes, or between major and minor cycles, etc.

Surprisingly, the central theme shifts again in the closing chapters. On the one hand, Chapter VIII (pp. 152–169), after a well-organized and documented analysis of the Bank's relations to the money market, comes to the conclusion that, by 1914, as most of the time before, the "Old Lady" had the market well under control. This result is not entirely convincing and needs revision in the light of a study of the market "organization," and of the "qualitative" developments in the credit structure. At any rate, it is actually contradicted by the next chapter (pp. 170–82), in which the author points out what seems to be his main contention, namely, that central banking policy in the pre-War type of gold standard is badly handicapped by international capital movements. They make any control of a "boom" by discount rates and other methods virtually impossible through attracting foreign funds. How, then, was the Bank more often than not in a position to control the market, as the author himself contends? He does not seem to feel that his criticism of the gold standard based on the one argument is actually offset by the other; and that, of the two, the second has apparently the better foundation in the facts which he has dug out himself.

MELCHIOR PALYI

The University of Chicago

National Economic Security, by Arthur B. Adams. Norman, Oklahoma: University of Oklahoma Press. 1936. 328 pp. $2.50.

This volume presents an analysis of the causes of the depression, a comprehensive and critical appraisal of New Deal recovery and reform policies, and advances a definite program for the furtherance of "permanent prosperity for all." The author finds that the depression commencing in 1929 was not only more severe than any preceding one but that it, and the preceding boom, were basically different in character from earlier cycles. Not only had "a surplus market supply of many classes of goods and a surplus capacity of production in most industries" developed, "long before the beginning of the depression," but in the midst of "our greatest peacetime boom, a surplus rather than a shortage of labor developed." This situation Dr. Adams attributes "to the rapid displacement of laborers by automatic machinery in production." As a result, he says, "there was little increase in real wages" at the time of the great rise in the volume of industrial production. Profits and savings "rose more rapidly during the twenties" while "laborers as a class received less benefits from the industrial upswing" than in any previous boom. And finally, "there was never a time when as large a portion of the national income was saved and invested as in the twenties; also there was never a time when current production exceeded current consumption as much as it did in this period."

Thus Dr. Adams subscribes without reservation to the over-saving underconsumption theory of the depression. This conviction, although not adequately supported by statistical evidence, colors his appraisal of the Roosevelt recovery program and conditions his own recommendations for permanent prosperity. Natural recovery, in his opinion, is quite impossible, for the nation has passed from "an era of a scarcity of capital funds and productive capacity to one of a surplus of capital funds and a scarcity of markets"; it is no longer possible to "exploit vast untapped natural resources"; nor is it likely "that the demand for new equipment or for funds with which to expand existing industrial enterprises will be large in the near future." This last sentence might just as well have been quoted from the report written just fifty years ago by Carroll Wright, the first Commissioner of Labor of the United States. Surveying the amazing accomplishments of the preceding half century from the depths of the first Cleveland depression, Dr. Wright was led to conclude lugubriously that the real work of the world had been completed and that "the day of large profits is probably past." Of course, the fact that Dr. Wright was wrong in 1886 does not prove that Dr. Adams may not be right in 1936, but it does leave room for reasonable doubt.

Although believing that it was necessary for the Government to "do something" to promote recovery, Dr. Adams is far from subscribing to everything that was done under the New Deal program. The Roosevelt monetary policies he deplores as a futile and dangerous experiment which at best might lead to an abortive recovery based on "the quicksand of inflation" rather

than the solid foundation which might have been established by adjustment of production costs to a lower price level. The danger of uncontrolled inflation is greatly enhanced, in the author's judgment, by continued deficits and increasing public debt which, if continued much longer, will lead to paper money.

The Administration measures designed to relieve agricultural and urban debtors and the Federal regulation of securities and exchanges enlist Dr. Adams' sympathy, but he is less enthusiastic about the relief program, and toward social security he is only lukewarm for, "the kind of economic security which is most vital is that security which comes from opportunities to earn a good living and provide for family and old age."

The author's own recommendations are based upon his belief that, "the fundamental economic difficulties which stand in the way of national progress and greater economic security are unemployment and unequal distribution of income in the nation." Because too large a share of the nation's income goes to those who save and invest and too small a share to those who spend, "the operation of the so-called natural economic laws cannot be depended upon either to eliminate unemployment or to give to the mass of consumers adequate purchasing power with which to buy the goods industry can produce." To correct this condition "the Federal Government must exercise more regulation and control . . . over the distribution of the national money income and over the weekly hours of laborers." Large incomes and inheritances must be redistributed by taxation and interest, profit and wage rates so controlled as to give small income receivers a larger share, while the unemployed are to be "absorbed" by adoption of the thirty-hour work week.

The farmers, too, would be regimented with a vengeance under Dr. Adams' scheme, and with no nonsense about benefit payments. The Federal Government would be given "power to allot to each farmer the maximum quantity of each major agricultural product he may be permitted to produce and sell each year," with "heavy penalties for those who exceed their production allotment."

Curiously enough, after bestowing the blessings of regimentation and monopoly on labor and agriculture, Dr. Adams would deny them to industry. Any and all "agreements by industries through trade associations or otherwise in reference to prices or volume of production" would be prohibited and the "anti-trust acts against monopolistic activities and restraints of trade" would be rigidly enforced, although a "limited amount of self-regulation of trade practices" would be permitted. Federal incorporation would be required for all inter-state business and the evils of overcapitalization and corporate financial manipulation would be eradicated by vigorous Federal regulation.

Thus Dr. Adams' Utopia appears to be a curious mixture of free competition and government planning, of collectivism and individualism, of an economy of scarcity and an economy of plenty, of sharing wealth and sharing poverty. Whether or not the program advocated by Dr. Adams can be ac-

cepted in its entirety as being sound or feasible, however, his book can be highly recommended as an able exposition of the problems of the depression and of the governmental measures adopted to solve them.

FREDERIC DEWHURST

Committee on Social Security
Washington, D. C.

$2500 a Year, by Mordecai Ezekiel. New York: Harcourt, Brace and Company. xv, 328 pp. $2.50.

One of the economists of the Department of Agriculture, intimately acquainted with the procedure of planned restriction of output under the A.A.A., and also familiar with the type of industrial planning tried under the N.R.A., here addresses himself to the problem of bringing about balanced and steadily increasing production by industry for the purpose of raising the general level of living, and doing so without a social revolution which might substitute a different system for capitalism.

His premises are the generally conceded ones that we have the equipment, skill, and labor energy to turn out many more goods than we have produced even in prosperity, and that the chief obstacle is lack of purchasing power, arising from maladjustments among prices, wages, and production schedules. It is possible, he believes, to work out a rough sketch-plan or blueprint for a national economic program, specifying increases in output for the several industries, and balancing the industrial programs with one another so that just the right amount of materials would be available for the processing industries, and the finished goods would be adjusted in quantity and variety to the demands of the population for a higher standard of living. It would also be possible, with increased output, to adjust wages and prices so that effective demand for the goods produced would clear the markets, without abolishing profits, and even while somewhat increasing them. The task of elaborating such a program in detail is admittedly one of enormous difficulty, but Dr. Ezekiel presents a thoughtful treatment of the major problems involved and a number of fertile suggestions for attacking these problems.

The unique contribution of the book, however, lies not in these fields, which have been the subject of much discussion in recent years, but in the suggestion of a politico-economic technique for putting the program into effect. How can private business be induced to have faith in such a scheme and cooperate in effectuating it? Dr. Ezekiel suggests a modification of the A.A.A. plan. After the blueprint program was worked out industry by industry, and the desired amount of production was allotted to the single members of each industry, the several employers would be given a chance to sign voluntary contracts, by the terms of which the Government would offer bonuses to those who agreed to produce given amounts at given prices and at given wage levels. The output, prices and wages would be so calculated as to provide to the cooperating concerns a larger volume of profits

than at present, though the profit per unit would be cut by price reductions or wage increases. The bonuses would be supposed to offset any additional gains that might be made by concerns which declined to cooperate and operated at lower wages and higher prices. Money for the bonuses would be collected from processing taxes or general sales taxes, but these would not be sufficient to counteract the benefit to consumers from the larger output and purchasing power which operation of the program would bring about. It would be safe for each individual concern to enlarge output because of the planned assurance that employment and demands for materials would steadily grow throughout industry—a condition which now does not obtain during the recession and depression phases of the cycle.

The difficulties obvious in such a plan are briefly discussed by Dr. Ezekiel. He believes that labor would cooperate, given advancing real wages and reasonable adjustment machinery. He suggests the introduction of flexibility in quotas to allow for the superior energy or better management of new or progressive companies. In the reviewer's opinion, he devotes far too little consideration to the questions involved in the existence of marginal and high-cost units. Any quota plan, whether for reducing or increasing output, is likely to fall afoul of a wide distribution of costs in any given industry. This would be particularly disastrous in a scheme which seeks as a major objective greater economic efficiency. The problem is not so grave at a time of depression (and the book was written with an eye on the desire for recovery), but when fuller operation has come it might be crucial. Such major collateral questions as the control of investment and credit in pursuance of the program also receive scant consideration.

In spite of inevitable defects in a pioneer endeavor of this sort, the book is ingenious and would have a substantial social value if what our society primarily needed were more intelligence and could use rational suggestions for reform, no matter how far-reaching. It is not likely, however, that a thoroughgoing plan like this would be adopted by either industry or government except at a time when social collapse was so imminent that something less rational or more drastic were the more probable outcome.

GEORGE SOULE

The New Republic

Consumer Market Data Handbook: 1936, by Raleigh W. Dawson. Washington, D. C.: U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce. Market Research Series No. 15. June, 1936. iv, 373 pp. 50 cents.

The third in a series of important steps which the Department of Commerce has taken toward the elimination of waste in distribution, through the assembly of market statistics and their presentation in readily usable form. Prior to 1929, when the first of the handbooks was issued, it was necessary for those engaged in measuring markets and setting up sales quotas to turn to many sources, both governmental and private, in the search for

data. Up to that time, furthermore, a number of the series now appearing in the handbooks were not available to the general public in any form.

The present volume contains two major tables, the first including data on population, retail and wholesale sales, service, amusement and hotel receipts, postal receipts, personal income tax returns and wired homes; and the second dealing with motor vehicles registered, residence telephones, number and value of farms, A.A.A. payments, the number of persons on relief and relief expenditures. The first table gives figures for all incorporated places of more than 2,500 population, for the remaining area within counties, and for counties as a whole. County totals represent the smallest subdivision of the second major table. For a number of series, per capita data and percentage relationships are given—a great saving of labor on the part of users of the book since, by inspection, they can detect the relative purchasing power of the various areas as denoted by the series in question.

The introduction provides a useful guide to statistical technique in establishing market potentials. Illustrations of the actual application of marketing data to the problems of distribution should prove highly suggestive to business men who wish to increase the efficiency of their sales operations. In addition to its usefulness to distributors of consumer goods the handbook should be of interest to banks, publishers, students of marketing, and to anyone interested in the standard of living of persons residing in particular geographic areas.

A few minor criticisms come to mind. From the standpoint of convenience in reading the figures, the format of the tables could be improved. One series of data—per capita retail sales for rural areas—might profitably have been omitted. Since this series denotes merely the sales of outlets in rural areas prorated over the population in those areas, it is not significant as an index of buying power of persons residing in places of less than 2,500 population.

On the whole, the 1936 handbook represents a step forward in market research. With its predecessors it affords an indication of trends, which, it is hoped, may be continued in later editions. Thus a body of statistics would be made available which would reveal changes in consumer standards in the components of the national market over a period of years.

PAUL W. STEWART

Anderson, Nichols, Associates, Inc.
New York, N. Y.

World Immigration, with Special Reference to the United States, by Maurice R. Davie. New York: The Macmillan Company. 1936. x, 588 pp. $3.75.

Professor Davie has written a book on immigration that is a pleasing exception to the common run of dry-as-dust repetitions of the statistics of the number, age, sex, and country of origin, etc., of the "old" and "new" immigration. He also departs from the traditional treatment of the problem in that he pleads no special cause. The central theses, if such they may be called, are: First, that immigration is largely a middle-class movement and,

secondly, that the problem of the future in countries with a highly restrictive immigration policy is "largely one of assimilation." The book decidedly is not a treatment of the subject "upon the broad basis of the universal restlessness of man," as it has been characterized by one reviewer.

The first few pages give the usual class-room distinctions between "colonization," "immigration," "invasion," and "conquest." But this class-room pedantry lifts very rapidly, and Professor Davie's sense of the real asserts itself with compelling force. There follow nearly six hundred pages of the story of the thrilling adventure of tens of millions of people, who in their ceaseless search for a freer and more abundant life have, in the past one hundred years, populated three new continents. The author endows his statistical material with a peculiar freshness and meaning, and he balances argument and counterargument with a detachedness that carries conviction. With almost artistic deftness he manages to lift from their original domicile more than a score of races and creeds and nationalities, to follow them in their voyage across the lands and seas; to evaluate the reasons for their leaving the homeland and the vicissitudes of settling and acclimatization in the new lands; to characterize the cultures, the racial heritages, and the economic rivalries of these diverse peoples, as they clash in the countries of emigration and immigration, endowing it all with a sense of sympathy and good humor rare in scholarly literature.

Professor Davie is uncommonly aware of the futility of definitive characterization of the effects of immigration. He is not one of those "students of the immigration problem" who at one and the same time dogmatically assert that immigration has been both the cause of the growth of trade unionism in the United States and an impediment to that growth; that it has caused both the acceleration and retardation of the introduction of labor-saving devices in American industry; that it has been the cause of the decline in the birth rate as well as the contributor to an overpopulation of not quite the right sort of humans; that immigration was responsible for our slums and our juvenile delinquency and pauperism and crime, feeble-mindedness and the insane, and for our corrupt politics and the Continental Sabbath. He is not convinced by the "proofs" of the eugenicists that our "new" immigration is racially inferior to the "old" immigration, as, apparently, the old immigration had been inferior to the yet older immigration, back to Leif Ericson. He does not agree with a certain group of university sociologists that our immigrants are "descendants of those that always stayed behind." Professor Davie has read his history and is aware of the fact that the immigrants of every generation were so thought of by the immigrants of every preceding generation.

Professor Davie has delved deeply into the almost inexhaustible literature of the field. The bibliographies, given at the end of each chapter, are the most exhaustive that this reviewer has come upon in any one volume or series of volumes on this subject. In its completeness and with respect to its topical arrangement, it is in itself a rich contribution to the literature.

The reviewer has but two major criticisms to offer. Professor Davie no-

where attempts to substantiate his thesis that immigration is of an "essentially middle-class nature." Indeed, Professor Davie is fully aware of the fact that immigration to America has been mainly a movement of the European peasantry and laboring classes (pp. 253 ff., p. 244 particularly). With reference to the period since 1880, Professor Davie states (page 238): "Recent immigrants have been largely peasants and farm laborers from the less industrialized countries of Europe. About four-fifths are unskilled laborers without previous experience in mining and manufacturing yet they find work mainly in these industries."

Secondly, Professor Davie fails to do full justice to the question of the circumstances that led, in 1924, to the complete reversal of our century-long immigration policy. How did it happen, after a century of apparently irreconcilable opposition between capital and labor in the matter of free immigration, that capital suddenly, apparently, capitulated to labor's historic demand for restriction? What were the historic moments of the time? Professor Davie missed fire here. Undoubtedly, this is due to his failure to perceive the essentially selfish role played by the earlier labor organizations of skilled crafts in this country in their almost overt collaboration with their employers in the harsh treatment of our immigrant labor.

Admittedly, these are questions that require considerable study, not possible in a volume replete with so much other material as is *World Immigration*. Perhaps Professor Davie was aware of this fact. Let us hope that in the not very distant future a scholar of Professor Davie's mettle, possessing the facility and felicity of his pen, will undertake such a study. In these questions lies the essence of world immigration.

JOSEPH M. GILLMAN

Washington, D. C.

The General Theory of Employment, Interest and Money, by John Maynard Keynes. London: Macmillan and Company. 1936. xii, 403 pp. $2.00.

A book by Mr. Keynes on fundamental questions which are right at the heart of the practical discussions of the day is no doubt an event. Those who had the opportunity to witness the expectations of the best of our students, the impatience they displayed at the delay in getting hold of their copies, the eagerness with which they devoured them, and the interest manifested by all sectors of Anglo-American communities that are up to this kind of reading (and some that are not) must first of all congratulate the author on a signal personal success, a success not in the least smaller in the cases of negative reaction than in those in which the book elicited fervent admiration. The unfavorable reviews in a sense but testify to the reality of that success, and I for one, being about to write another of those unfavorable reviews, heartily rejoice in this implication and wish it to be understood that what I am going to say is, in its own unconventional way, a tribute to one of the most brilliant men who ever bent their energies to economic problems. Expression of a teacher's gratitude should be added for the gift of

what is, in its vigorous exposition and extreme simplicity, an invaluable starter of discussions. Speaking to us from the vantage ground of Cambridge and from its author's unique personal position, defended by a group of ardent and able disciples, the book will undoubtedly dominate talk and thought for some time.

In his preface Mr. Keynes underlines the significance of the words "General Theory" in his title. He professes to address it primarily to his fellow economists and seems to invite purely theoretical discussion. But it is not quite easy to accept that invitation, for everywhere he really pleads for a definite policy, and on every page the ghost of that policy looks over the shoulder of the analyst, frames his assumptions, guides his pen. In this sense, as in another, it is Ricardo all over again. The advice offered implicitly and the social vision unfolded explicitly, do not concern us here. That advice (everybody knows what it is Mr. Keynes advises) may be good. For the England of today it possibly is. That vision may be entitled to the compliment that it expresses forcefully the attitude of a decaying civilization. In these respects, this book invites sociological interpretation in the Marxian sense, and nothing is more certain than that such interpretation will be administered to it before long.

It is, however, vital to renounce communion with any attempt to revive the Ricardian practice of offering, in the garb of general scientific truth, advice which—whether good or bad—carries meaning only with references to the practical exigencies of the unique historical situation of a given time and country. This sublimates practical issues into scientific ones, divides economists—as in fact we can see already from any discussion about this book—according to lines of political preference, produces popular successes at the moment, and reactions after—witness the fate of Ricardian economics—neither of which have anything to do with science. Economics will never have nor merit any authority until that unholy alliance is dissolved. There is happily some tendency towards such dissolution. But this book throws us back again. Once more, socialists as well as institutionalists are right in judging economic theory as they do.

Ricardian as the book is in spirit and intent, so it is in workmanship. There is the same technique of skirting problems by artificial[1] definitions which, tied up with highly specialized assumptions, produce paradoxical-looking tautologies, and of constructing special cases which in the author's own mind and in his exposition are invested with a treacherous generality. In one fundamental point it actually falls short of the line already reached by those writers who in the sixties of the past century criticized some of the tenets of what *to them* was "classical" doctrine,[2] notably Longe and Thorn-

[1] The definition of involuntary unemployment, page 15, may serve as an example. Taken literally (which of course it would be unfair to do) it would mean that there is no practically conceivable case in which workmen are not partially unemployed by definition. For if prices of wage goods rise a little, other things being equal, it is clear that both the demand for, and the supply of, labor will increase under competitive conditions, the latter at least as long as the flexibility of the marginal utility of income to the workmen is what present statistics lead us to believe.

[2] Mr. Keynes' definition of the word "classical," which is made to include Professor Pigou, who

ton. These knew perfectly that the old supply and demand apparatus renders its very limited service only if applied to individual commodities, strictly speaking to individual commodities of relatively small importance, and that it either loses or changes its meaning if applied to comprehensive social aggregates. This was in fact their foremost objection to the wage fund theory. Mr. Keynes' fundamental construction (which is all we can consider here) rests on a contraposition of expected[3] net "proceeds," equal to expected profits plus expected current payments to factors (for definition see page 24), and *those* proceeds the expectation of which would be sufficient and not more than sufficient to induce entrepreneurs to decide on producing the corresponding output. Two schedules or functions are imagined in order to describe the behavior and the relation to one another of these two fundamental variables. The analogy of the first with the ordinary Marshallian demand curve and the analogy of the second with the ordinary Marshallian supply curve are obvious. In fact, Mr. Keynes speaks of Aggregate Demand in the one case and Aggregate Supply in the other and makes them yield a unique "point of intersection." There is as little justification for this extension of the "Marshallian cross" as there is for its application to the case of money, which has remained a besetting sin of the Cambridge group to this day.

Transition to the central theme of the book is effected by relating those two fundamental variables not to output but to employment, and not to employment of resources in general but to employment of labor. Mr. Keynes is as careful to point out that number of workmen employed is not proportional to output as Ricardo was to point out that value cannot be proportional to quantity of labor. But exactly as Ricardo reasoned as if it were, so Mr. Keynes assumes that employment of labor is an "adequate" index of the output resulting from it. The arguments offered by both authors, in support of what is a procedure obviously inadmissible in anything that pretends to be a "general" theory, are curiously alike. In particular both display a desire to banish the variations of output—or, in Ricardo's case, of "riches"—from the realm of theory.

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cannot be counted among classics by virtue of any criterion except the one of outstanding achievement, reminds me of a little experience I had in a group of students. I observed that one of the members kept on referring to a highly unconventional proposition as "orthodox." I asked him why he did so, seeing that the proposition was no part of received doctrine. His answer was, "I simply call orthodox everything I don't like." Protest should be filed in passing against Mr. Keynes' methods of criticism. But beyond that it is regrettable that so brilliant a leader should set so bad an example of utter absence of *verecundia*. I am no Marxian. Yet I sufficiently recognise the greatness of Marx to be offended at seeing him classed with Silvio Gesell and Major Douglas. Mr. Keynes is unjust even to Major Douglas for there is no warrant whatever for thinking little of that writer once one has accepted the views of this book. Certainly Marx and the classics (in the proper sense of the word) were grievously at fault in very many points as it is natural that pioneers should be. Yet they are right as against Mr. Keynes. His attitude toward Marshall's teaching is for Marshallians to judge.

[3] The emphasis on *expected* as against *actual* values is in line with modern tendencies. But expectations are not linked by Mr. Keynes to the cyclical situations that give rise to them and hence become independent variables and ultimate determinants of economic action. Such analysis can at best yield purely formal results and never go below the surface. An expectation acquires explanatory value only if we are made to understand *why* people expect *what* they expect. Otherwise expectation is a mere *deus ex machina* that conceals problems instead of solving them.

It should be clearly realized what that means Readers of this *Journal* will shrug their shoulders at a theory which deserts the statistician in his struggle with the momentous problems surrounding the Index of Production. But disregarding this, reasoning on the assumption that variations in output are uniquely related to variations in employment imposes the further assumption that all production functions remain invariant. Now the outstanding feature of capitalism is that they do not but that, on the contrary, they are being incessantly revolutionized. The capitalist process is essentially a process of change of the type which is being assumed away in this book, and all its characteristic phenomena and problems arise from the fact that it is such a process. A theory that postulates invariance of production functions may, if correct in itself, be still of some use to the theorist. But it is the theory of another world and out of all contact with modern industrial fact, unemployment included. No interpretation of modern vicissitudes, "poverty in plenty" and the rest, can be derived from it.

The central thesis that under-employment can exist in a state of stable equilibrium and that saving is responsible for it is then made to follow from two additional hypotheses. The one—embodied in the concept of Propensity to Consume—is that "when aggregate real income is increased aggregate consumption is increased, but not by so much as income" (page 27). This Mr. Keynes dignifies, in the worst style of a bygone age, into a "Psychological Law." The question of fact apart—statistics of installment selling and other forms of consumers' credit obviously suggest the possibility of doubt—such a "propensity" is again nothing but a *deus ex machina*, valueless if we do not understand the mechanism of the changing situations, in which consumers' expenditure alternatively increases and contracts, and redundant if we do. Postulating, however, an independent and systematic tendency to that effect, Mr. Keynes finds a "gap" in expenditure resulting from it which may or may not be filled by investment and tends to widen as communities grow more wealthy. This amounts to introducing another hypothesis: the hypothesis of failing "Inducement to Invest."

Since Mr. Keynes eliminates the most powerful propeller of investment, the financing of changes in production functions, the investment process in his theoretical world has hardly anything to do with the investment process in the actual world, and any proof, even if successful, that (absolutely or relatively) falling "Inducement to Invest" will produce under-employment would have no greater practical importance than a proof that motor cars cannot run in the absence of fuel. But that proof, even under its own assumptions and granting that in Mr. Keynes' world there would be a systematic tendency for Inducement to Invest to grow weaker,[4] meets the obvious objection that Propensity to Consume and Inducement to Invest are not independent of each other. In some passages (for example, page 30) Mr.

[4] To many people statement of such a tendency will sound "realistic." This is however entirely due to recent experience and would have equally been the case after, say, 1720 or 1825 or 1873. No support of the theory in question can be derived from this, since it rests exclusively on observation of the surface mechanism of a deep depression *already in progress*, the explanation of which must be worked out independently of it.

Keynes seems indeed to hold that they are. We can absolve him, however, from the grave error this would spell, because each time (for example, page 31) he in fact admits the existence of an equilibrating mechanism. But then the whole *theoretical* case, that is, the case in terms of fundamental features of the economic process, collapses, and we are *practically* left with friction, or "stickiness," institutional inhibitions, and the like, which in particular may prevent the rate of interest from reacting promptly or, in general, prevent the whole of that equilibrating mechanism from functioning adequately.

Space forbids our entering into a discussion of the Multiplier, its relation to the Propensity to Consume, the system of Wage Units, and other tools by means of which Mr. Keynes works out his basic ideas. I wish however to welcome his purely monetary theory of interest which is, as far as I can see, the first to follow upon my own. Unfortunately, I must add that the similarity stops there and that I do not think my argument open to the objections which this one is sure to meet. Some differences would vanish, if the concepts of a demand for money stocks and of "liquidity preference"—which is another *deus ex machina;* there is a whole Olympus of them—were replaced by concepts drawn from the economic processes that lie behind the surface phenomena denoted by those two. But then many of the striking inferences would also vanish. The whole vision of the capitalist process would change. Interest would lose the pivotal position which it holds in Mr. Keynes' analysis by virtue of the same technique which made it possible for Ricardo to hold that profits depend upon the price of wheat. And a completely different diagnosis of modern difficulties would follow.

The less said about the last book the better. Let him who accepts the message there expounded rewrite the history of the French *ancien régime* in some such terms as these: Louis XV was a most enlightened monarch. Feeling the necessity of stimulating expenditure he secured the services of such expert spenders as Madame de Pompadour and Madame du Barry. They went to work with unsurpassable efficiency. Full employment, a maximum of resulting output, and general well-being ought to have been the consequence. It is true that instead we find misery, shame and, at the end of it all, a stream of blood. But that was a chance coincidence.

JOSEPH A. SCHUMPETER

Harvard University

The Economics of Inflation, The Basis of Contemporary American Monetary Policy, by H. Parker Willis and John M. Chapman. New York: Columbia University Press. 1935. xi, 443 pp. $4.50.

This book puts into printed form the proceedings of the Banking Seminar of the School of Business of Columbia University, apparently principally in the academic year 1933–34. Part I was prepared by Professors Willis and Chapman, in charge of the course; Part II, the contribution of the 13 student members of the seminar, is made up of various short statistical, histori-

cal and analytical studies, which to some extent provide the detailed background for Part I.

The plan of the book doubtless has certain advantages in permitting more prompt publication than if all the material had been thoroughly assimilated into one integrated whole. Moreover, for the purposes of some one who wants to make a study of the various aspects of inflation, the book as it stands might constitute a fruitful starting place because of the various points of view expressed, and because of the references, particularly in Part II, to various authorities. The disadvantages of the plan, however, are that the main ideas do not get as detailed and complete treatment as would be expected in a treatise of 430 pages of text and tables, whereas many ideas are repeated in an elementary form in a number of places. A further difficulty is that the several authors do not stick to the same definition of inflation throughout nor take the same attitude towards its various manifestations.

The rather unusual definition of inflation which Professor Willis proposes greatly affects the subsequent treatment, even though it is not adhered to throughout. His primary definition is (page 10): "an inflated or deflated condition is one in which voluntary action on the part of the State or of the community in general has established a set of economic relationships which is different from what would ordinarily have been established had it not been for such planning." It seems to the reviewer that this definition is rather far removed from accepted usage and covers so broad a possible field as to represent an undesirable innovation. Any attempt to use the definition as a criterion whether inflation had or had not occurred in a particular case would reveal that it is of practically no value because of the difficulty of deciding whether a certain action is or is not "voluntary" and whether a given set of economic relationships is or is not different from what would "ordinarily" have been established. As a matter of fact, most of the subsequent discussion modifies the definition somewhat by limiting the field in the main to voluntary action concerned with currency or credit and by looking for the principal effects of inflation in commodity, security, or real estate prices.

The supplementary essay on "Inflation in Current Economic Literature," by Anatol Murad, might well have been made more specifically the basis for the fundamental definition. After some keen criticism of the definitions of Professor Cassel and others, the following is finally worked out as a logical version of the usual view: "Inflation is the creation of purchasing power in excess of requirements for the production and consumption of goods at prevailing price levels provided there is no change in the processes of production and exchange." Although Mr. Murad expresses doubt that this definition really gets at the heart of the matter, it would seem to be more usable than the one actually adopted by Professor Willis.

The book as written, however, reflects Professor Willis' definition as quoted. He insists repeatedly that the existence or non-existence of inflation cannot be tested by the course of commodity prices; that the shift of bank

assets from commercial loans to corporate and Government bonds is inflationary; that the heart of inflation is an attempt to redistribute wealth and income; and that any economic or financial condition resulting from attempted central planning is inflationary. Perhaps because of this insistence on a broad definition of inflation and the consequent range of problems touched upon, Professor Willis' discussion frequently degenerates into dogmatic generalities. By classifying as "inflationary" all ideas of reflation, devaluation, stabilized dollar, and central planning, Professor Willis condemns them without adequate unprejudiced analysis and tries to spread over them the odium which properly attaches to the German mark type of inflation.

Another peculiarity of the treatment, in addition to this unusual method of defining inflation, which prevents the authors from really getting into the real vitals of the subject, is a failure to accept obvious historical facts as to the stimulating effect of devaluation on the dollar prices of international commodities. After listing the prices of certain commodities in November, 1932, and in November, 1933, Mr. D. J. Leahy, one of the students, says "We can recognize a distinct rise in each of the various price levels, but for the greater part we cannot suppose that the influence of exchange depreciation had more than a slight effect." Professor Willis himself says that there is no support whatever, in fact, for the claim that changes in the weight of the dollar had brought about corresponding changes in the wholesale prices of certain commodities.

In comment on these surprising statements, it is generally agreed that prices of commodities not directly affected by foreign trade showed little or no immediate change, and that the extent to which any average of commodity prices was affected by the reduction in the gold content of the dollar depends on what commodities are included in the average. But for standard raw materials like cotton, tin, and rubber, on which there were no tariffs impeding the movement between the American markets and markets still closely linked with gold, and for which the cost of transportation was a small fraction of the price, it was logically inevitable that the American dollar prices should have moved in close parallelism with the price of gold and it was, in fact, obvious to those who watched them day by day that they were so moving.

Failure to appreciate these evident facts of record is not just a minor slip but completely forestalls any possibility of analyzing correctly the effect of the gold devaluation policy, which in the case of cotton alone put the southern cotton producers back on the road to solvency. The argument as to the wisdom of the devaluation policy is of course not settled when these facts are conceded, but it is at least begun on a realistic basis.

Attention must be called to an error in elementary statistical inferences on pages 166 and 167 of Chapter IX, "The Farmer and Inflation." Professor Chapman reproduces two tables comparing index numbers for prices received for farm products and for prices paid by farmers for commodities bought, one table being stated with 1910–1914 = 100 and the other with 1923 –1925 = 100. Professor Chapman says that the second table "shows that the

farmer fared better than the manufacturing group for the period 1910–1914 whereas the other data indicate that the two classes of prices were almost the same when adjusted for the full period, agriculture having a very slight disadvantage." This remarkable deduction of two different conclusions from two versions of the same set of index numbers depends on the erroneous assumption that index numbers compare absolute values rather than conditions relative to the base year. The correct statement, of course, is that the second table (or the first table) shows that prices received by the farmer in the period 1910–1914 were on the average not so far below prices received in 1923–1925 as the prices paid by farmers in 1910–1914 were below prices paid in 1923–1925.

Because of the failure to adopt and adhere to a sound definition of basic concepts, the refusal to recognize certain essential facts, and the inadequate use of statistical methods, the general treatment does not inspire confidence. A further lack of scholarly excellence is the frequent allusion to ideas supposed to be advocated by others without specific reference to direct quotation. All things considered, the book is not recommended for general use, although some of the sections in Part II, which it is obviously impossible to discuss in detail here, make real contributions toward an understanding of certain phases of the subject.

ROBERT W. BURGESS

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The Money Supply of the American Colonies before 1720, by Curtis Putnam Nettels. Madison, Wisconsin: University of Wisconsin. 1934. xviii, 300 pp. $2.00.

Based almost entirely on primary sources, including the colonial records in English and American archives, this monograph supersedes all previous studies of the early history of colonial currency. The product fully justifies the "seven or eight years" of labor involved in its preparation.

The difficulty of maintaining an adequate domestic supply of money (in the face of a bimetallic ratio chronically divergent from the market ratio, the drainage of specie to the East Indies, and the failure to grasp the principles governing a subsidiary coinage) and mercantilist predilection for the precious metals prevented the mother country from allowing exports of money to the colonies. In order to preserve the yield of proprietary dues, quit rents, and private indebtedness, numerous petitions to establish mints in the colonies were steadfastly denied. "Masschusetts did erect a mint in 1652, and thereby became guilty of usurping the King's prerogative. Partly for this reason she lost her charter in 1684." The chronic scarcity of coin gave rise to commodity money, which "differed from simple barter in one important respect. The various colonial assemblies enacted that certain products should be received in payment of taxes and all other public debts. These commodities were then called current money, or in some places,

country pay." At some time in one or more colonies wampum, tobacco, wheat, beef, pork, peas, Indian corn, barley, rye, flax, hemp, wool, fish, lumber, pitch, tar, cattle, dairy products, and several other articles served as a medium of exchange and a measure of value. The lack of such characteristics of good money as durability, divisibility, transportability, storability, and (above all) homogeneity and stability of value rendered these commodities unsuitable for monetary use. It was the heterogeneity rather than the bulkiness of tobacco that gave rise to the circulation of warehouse receipts. The chronic overproduction of tobacco resulting from its use as money should give pause to the advocates (if there are any left) of the Edison-Ford nostrum for monetary reform.

Most of the specie in the colonies consisted of Spanish eight-real pieces, or pieces of eight; but some English and Portuguese coins were also in circulation. The well-known competitive overvaluation of pieces of eight in the colonies reflected the lack of legislative unity in monetary affairs, mercantilist worship of the golden calf, and a scarcity of coin. Believing that this policy would attract specie and thus stimulate the development of industry and divert attention from the production of staple raw materials, England restricted the overvaluation of foreign coins by the Southern colonies from the beginning. At the instigation of the Board of Trade a royal proclamation of 1704 "declared that the standard piece of eight of seventeen and a half pennyweight should not pass in any colony at more than 6s."; but no sanctions were provided. Successful resistance to the proclamation by Massachusetts, Pennsylvania, New York, and South Carolina (the four leading commercial colonies) "forced the Board of Trade to act again." In 1708, Parliament passed an act prescribing "that any person in the colonies who, after May 1, 1709, paid or received coin in discharging debts contracted after that date should be imprisoned six months or pay a fine of £10 if the coin exchanged bore a value higher than the proclamation rate." In an effort to avoid deflation rather than to achieve additional inflation "several of the colonies evaded the new law as effectively as they had evaded the proclamation."

The earliest recorded instance of paper money issued by a government occurred in the American colonies. To pay soldiers who threatened to mutiny following an abortive attack on Canada in 1690, Massachusetts issued the first of the bills of credit which were destined to plague America until abolished by the constitution. The extensive use of private credit, the wide circulation of bills of exchange, and the issuance of tax anticipation warrants had prepared the way for the fiduciary issues. In 1703, South Carolina emitted bills of credit to defray the expenses of an expedition against Saint Augustine; and by 1715 all the colonies except Pennsylvania, Maryland, and Virginia had succumbed to the paper money contagion. At first the bills of credit were not legal tender; taxes were provided for their redemption; emergencies were either the pretexts or the causes of their issue; the quantity was moderate; and the bills circulated at or near par. Before 1720, however, the colonies made heroic efforts to force the circulation of bills of

credit at par; the taxes pledged for their redemption were extended several years into the future; canceled bills were promptly reissued; the quantity was excessive; and sharp depreciation was the inevitable consequence.

Dr. Nettels examines Adam Smith's and David Ricardo's analysis of the depreciation of colonial bills of credit and accepts Ricardo's ascription of the phenomenon to overissue. Neglect of the discussion of bills of credit by Sir James Steuart and other mercantilists presumably resulted from limitation of space, for Dr. Nettels is obviously familiar with the literature of mercantilism and colonial policy. The tireless energy displayed in the collection and analysis of data strikingly contrasts with the obvious carelessness in proofreading. Much more serious is the strong tendency toward uncritical acceptance of the contemporaneous complaints of a shortage of money. Vehement protests against an inadequate currency were rife in Spain during the Price Revolution of the sixteenth century, in America during the Civil War, and even in Germany under hyper-inflation. The most serious deficiency is the failure to examine the alleged dearth of coin in the light of the Ricardian specie-flow mechanism. Had specie been as scarce as Dr. Nettels seems to believe, why would not prices have fallen sufficiently below the world level to induce an influx of specie into the colonies? May not commodity money and paper currency have been causes rather than consequences of a scarcity of coin? One must admit, however, the possibility that such factors as imperfect markets, colonial exclusionism, and the lack of transportation facilities obstructed the normal "pull" of prices on specie.

Dr. Nettels has not only written an excellent monograph on "The Money Supply of the Colonies" but also provided (largely from documentary sources) a wealth of information concerning commerce between England and the Spanish American colonies; intercolonial trade; the economic relations of Boston, New York, and Philadelphia; British colonial policy; piracy; industrial and agricultural development of the different regions; trade between England and the colonies; and the economic philosophy of the period. This is one of the greatest contributions to American economic history in recent years.

EARL J. HAMILTON

Duke University

Money, Prices, and Wages in Valencia, Aragon, and Navarre, 1351–1500, by Earl J. Hamilton. Harvard Economic Studies, Volume LI. Cambridge, Massachusetts: Harvard University Press. 1936. 310 pages. $4.50.

Two years ago, Hamilton presented an analysis of the price revolution in Spain from 1501 to 1650.[1] That study showed that following the discovery of precious metals in the new world commodity prices rose six times and that this rise was about in proportion to the imports of precious metals.

The second volume of Hamilton's work covers prices, wages, and money

[1] Hamilton, E. J., *American Treasurer and the Price Revolution*, Harvard Economic Studies, Volume XLIII, 1934.

in North Eastern Spain during the century and one half prior to the discovery of America (1351 to 1500).

The first two-thirds of the book, containing thirty tables and twenty-one charts, is divided into three parts dealing with Valencia, Aragon, and Navarre. The most valuable material was found in Navarre. Each part is subdivided into three sections dealing with money, wages, and prices. The last third of the book, the appendix, gives detailed statistics of coinage, prices, and wages.

The study was based on an analysis of public, private, and ecclesiastical documents in many parts of Spain. Differences in weights and measures, arising from the same or different names or the same or different quantities, plus the confusion of coins of variable weight, made Hamilton's job a most difficult one. The book contains copious footnotes of sources. The author was not given to indiscriminate generalization and frequently warns the reader of the limitations of the data.

Hamilton's evidence would indicate that from 1351 to 1380 prices in terms of gold rose because of increasing supplies of gold discovered in Silesia and Hungary. From 1381 to 1425–45, the level of prices in fixed weights of precious metals was generally downward. Valencia and Aragon, which did not participate in the flagrant inflation that occurred in many countries, debased their coins moderately but not sufficiently to prevent a fall in commodity prices in terms of the money of account. In Navarre, the debasement was more severe, and commodity prices in money of account rose 3.0 per cent per year.

In 1346, Valencia adopted the gold standard despite the vigorous protests made to the King. In Aragon, gold prices moved more violently than the prices in the money of account.

In Valencia and Aragon, real wages were comparatively stable. In Navarre, nominal wages rose more than prices, but real wages lagged in the advance.

Hamilton was fortunate in that he could study the time lost in the building trade on account of holidays. Excluding Sundays, religious holidays were 38 per year, which was quite similar to the national and religious holidays in France.

There appeared to be a striking rigidity in craft division. Journeymen received wages about 39 per cent above the helpers. Earnings of stone cutters were 122 per cent of the earnings of carpenters' helpers; plaster helpers, 106; roof tilers' helpers, 105; adobe mason helpers, 99; mason helpers, 95; apple pickers, 90; and hoe hands, 80. Wages of women were about half those of men. Bull fighters' wages were 10 per cent more than carpenters'. Hired assassins generally received more than carpenters' wages.

Hamilton concludes that the rise of capitalism in Spain did not start until the discovery of America and the subsequent price revolution that accompanied the huge imports of precious metals into Spain.

The monetary theorist, hard or soft, will find food for thought; the chapters on wages will be of interest to the student of labor problems; and

the economic historian and that small but increasing number of scientists interested in index numbers and prices should read the book from cover to cover.

In the third volume, Hamilton will present an analysis of the secular trends and cyclical movements of prices.

F. A. PEARSON

Cornell University

Past and Present Facts about Money in the United States, by Paul Bakewell, Jr. New York: Macmillan Company. 1936. xvi, 221 pp. $2.00.

The author of this volume is a member of the bar and a former Professor in the St. Louis University School of Law. In his preface he discloses his reasons for writing this book. It is because he has found no single book which stated accurately the history of money in the United States. "Some books, which have been generally accepted as authorities," he says, "contain statements which are contrary to fact." He is not interested in the economists' view of money, nor in banking, credit, or price theory, but simply in money as "a creature of statute" and of court decisions. In his pursuit of "facts" Mr. Bakewell says: "I found the facts to be so contrary to certain ideas which have been generally accepted that I support each and every statement of fact by reference to a specific statute or to a court decision."

Part I of this book deals with monetary history up to 1933; Part II with changes since 1933. The first part seems to have no "facts" not found in basic texts. It does have some peculiar interpretations and novel definitions. Part II cites statutes and court decisions dealing with gold devaluation and silver.

On page 38 he says that "unthinking people" sometimes demand "cheap money" as a remedy for adverse economic conditions. But he explains: "money is valuable because it is dear: if it becomes cheap it loses value."

He also gets the reader confused by his peculiar contention that Congress can regulate the value of money but not the standard of value. In commenting upon recent legislation which changed the statutory price of gold, the author says the statute "does not make sense." But just why it does not make sense to change the price of gold from $20.67 to $35.00 an ounce is not explained. The author argues that "a statute which says that currency of a specified face amount is the equivalent of one amount of gold today, but of an entirely different amount of gold tomorrow, sounds like the talk of a mystic or prestidigitator." Mr. Bakewell is evidently unfamiliar with the free gold market in which the price of gold may fluctuate from minute to minute.

He cannot understand how Congress can change the "standard" of value. This is impossible, the author proves, by quoting the dictionary, that a standard is a "fixed" unit. And, he argues, a fixed unit can not be fixed if it is changed. The author seems to forget that the unit can be fixed at different values at different times and that few things are fixed for all time. Chapter

XXXII deals with this great difficulty. The author insists that once Congress has established a standard unit of value it does not have power to change it. Because if it can be changed it cannot be fixed forever. Ergo, the power to "fix" precludes the power to change. After reviewing the recent court decisions approving recent monetary changes the author still contends that the Supreme Court has not yet answered the question: "Can something that is fixed be changed?"

By his verbal juggling the author has thus created a dilemma for himself and for his readers. He has added no words of enlightenment and will leave confused and bewildered anyone not already fortified by familiarity with the theory of money and banking. His "facts" are mostly peculiar interpretations of his own and a mass of confused thinking. This book adds nothing to the subject, is of no value to the trained reader, and will simply muddle up and misinform the general reader.

W. A. MORTON

University of Wisconsin

The Downfall of the Gold Standard, by Gustav Cassel. Oxford: Oxford University Press. 1936. viii, 262 pp. $2.25.

Professor Cassel describes the actual working of the gold standard and emphasizes how different this has been from the theoretical. He gives an interesting account of the numerous international monetary conferences since the War. Since he has been a member of nearly all of these, the book contributes much to the trend of thought that is not given in the official reports.

> The international gold standard is by no means such an old and venerable institution as most people seem to believe.

He spent many years working for the reestablishment of the gold standard and on numerous occasions warned of acts endangering its success. It is, therefore, interesting to note his conclusions that the defects are insurmountable.

> The lesson of all this is that the international gold-standard system is a very dangerous mechanism.
> Gold has failed, both as a means of payment and as a standard of value.

Proposals for the reestablishment of the gold standard nearly always include a statement that somehow the value of gold is to be controlled. This implies the use of some other standard to which gold is to be made to comply.

> The programmes for a restoration of the gold standard are often coupled with recommendations for a policy aiming at stabilizing the value of gold itself. Such recommendations can have a logical sense only if some other measure of value is taken as a standard. Moreover, some restoration programmes regard a

more or less violent change in the value of gold in relation to commodities as a reason for adjusting existing gold parities. This means, however, that gold is actually dethroned from its position as a standard, and that we have to agree on some other standard of monetary stability.

Provisional stabilization seems to be a rather dubious proposal. Its very essence is a rejection of gold as a standard. Another standard must be set up by which the expediency of an eventual change of the gold parity should be judged. Such a standard is, for example, that of the British monetary programme at the London Conference, viz. after a preliminary rise of the general price-level, a stabilization of that price-level. If this objective cannot be attained on the basis of a given gold parity, the gold parity has to be changed.

Having realized that gold is a very unsatisfactory standard of value we have to find an essentially broader basis for monetary stability. Then, instead of fixing the price of one single commodity, as we do in the gold-standard system, we turn to an approximate fixing of the aggregate price of a great number of important commodities, or, what amounts to the same thing, we choose an index for the general level of commodity prices and decide to regard the invariability of this index as our standard of monetary stability.

When Sweden left the gold standard it was important that some other standard should be set up for the regulation of the Swedish currency. On being asked for my counsel I insisted upon a definite declaration to the effect that the maintenance of the internal purchasing-power of the Swedish krone as against commodities was the aim of Sweden's monetary policy. The natural fear that the abandonment of the gold standard would mean leaving the currency to the mercies of uncontrolled inflation could only be met by a declaration fixing a new standard for the regulation of the currency by the central bank. The decisions arrived at were in accordance with this view.

He calls attention to the opposite view and discusses how untenable it is.

On the other hand, opinions differ even as to the desirability of maintaining the general level of wholesale prices constant. Some authors propose that this level should be lowered in the same proportion as technical progress reduces 'costs of production.'

The above inquiry has disclosed the serious dangers connected with a return to gold as a basis of our monetary system. The main consequences that we have to fear from such a backward step are: in the immediate future, an exaggerated rise in prices based on the superabundance of revalued gold reserves; later on, a new shortage of gold with a repetition of the deflation and the depression that we have just gone through; generally, we would have to reckon with a periodically recurrent aggravation of economic crises resulting from that competition for gold and that enhancement of its value which would always follow extraordinary endeavours to secure liquidity; further, the whole series of disturbances connected with the very controversial question of an equitable redistribution of the world's gold reserves and of the use to be made of these reserves for the supply of means of payment; not to speak of the perturbations that would follow if countries again began to accumulate disproportionate gold reserves; the general strengthening of protectionism throughout the world that always ac-

companies an acute international competition for gold; and finally, the constant presence of that element of insecurity which is instilled into economic life by the fear lest existing gold parities might again be abandoned.

G. F. WARREN

Cornell University

Gold and Prices, by George F. Warren and Frank A. Pearson. New York: John Wiley & Sons, Inc. 1935. vii, 475 pp. $5.00.

What began as a book on agricultural prices several years ago has by now turned out to be an ambitious history of all prices, as well as a text on monetary theory. *Prices*, published early in 1933, has been brought up to date by the addition of statistical material for the year 1934. Five new chapters elaborate the authors' well-known theory of money.

A brief summary of their views may be helpful as a key to the contents of this most discursive book. The production of gold, they hold, is very irregular; it has little immediate relation to the demand for it; the result has has been the erratic price levels of the past seventy-five years. The periodic deflations which have characterized the history of prices over this period have become so telling in their effects as no longer to be tolerable. The authors recommend "some form of an all-commodity, or many commodity, dollar" (p. 295). Mere revaluation of the currency unit by a reduction in its gold content is no short cut to monetary stability, but rather a drastic expedient justified by the desperate situation faced by the Government in 1933.

More specifically, the old gold standard is looked upon as impracticable for the following reasons: (1) the proliferation of commodities and services under large-scale production, the lessening of individual and local self-sufficiency, have made for a rise in the number of transactions which is disproportionately large by comparison with the secular trend of business. The supply of gold available for monetary use has not been adequate for this ever expanding demand. To the stock answer to this contention: improvements in the efficiency of the modern banking process make a given amount of gold more effective in the monetary use, Warren and Pearson reply that there is no evidence to show that an ounce of gold would finance more transactions per year in 1929 than in 1900. (2) The woes of the debtor and taxpayer during a period of deflation are thoroughly aired as an argument against the fixed gold standard. (3) The argument for deflation as a necessary and wholesome process is looked upon as fatuous, in the light of the many "administered" prices, inflexible public utility rates, taxes, union wage rates, salaries, and handling charges. (4) Stability of wage payments is regarded unfavorably because the 1.7 per cent average annual rise in the productivity of labor should be reflected in higher wage rates. Thus, stable commodity prices and slowly rising wage rates would go together. "If total wages are stable, the only way to promote the highly efficient worker is by

lowering the inefficient worker. This is difficult to do. Therefore, the efficient worker is likely to fail to be promoted and incentive is lost" (p. 273).

Although the monetary theory of the authors gives a kind of unity to this work, the topics treated are so numerous and diverse as to defy classification. The principal subjects, however, are: the history of the prices of raw materials during the past century; the fluctuations in the production and value of gold since the discovery of America; the effects of the discovery of America on prices; detailed tables and charts dealing with the price history of wheat, corn, and other agricultural commodities; the price fluctuations in the three major crises since the Civil War; a short study of farm land and urban real estate values and building activity; taxes as related to farmers' incomes at the several price levels; purchasing power of wages since 1840 in the United States, including informative tables of the variations in the salaries of Government employes, school teachers, and college professors in periods of inflation and deflation; contrast of farm and city wage rates.

Most of these topics are treated in a sort of hit-and-run style. This method may leave the reader unsatisfied, but it has the virtue of permitting the authors to range widely. The net effect is stimulating.

The book should prove useful to university instructors as a compendium of illustrative reference materials. Besides, it is an inductive approach to the study of money. The innumerable illustrations of the operation of monetary forces, many homely and familiar, as the variation in the number of marriages in Saint Louis with the phases of the business cycle, must make Gold and Prices more interesting and readable for the novice than the conventional studies of money.

It is unfortunate that Professors Warren and Pearson did not develop their chapters on stabilizing prices and the price outlook further. They seem not to think it worth mentioning that every currency is managed. The modernized gold standard proposed to Congress by Mr. Warburg is nothing but a device for a paper currency loosely tied to a gold reserve, but everywhere under the management of the bankers.

GEORGE K. MCCABE

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Washington D. C.

State Bank Failures in Michigan, by Robert G. Rodkey. Ann Arbor, Michigan: University of Michigan, Bureau of Business Research. Michigan Business Studies. Vol. VII, No. 2. 1935. 69 pp. $1.00.

The principal subject for investigation in this study is the 163 Michigan state banks which failed between January 1, 1930, and February 11, 1933. With one exception, these banks were located outside Detroit. During the same period 411 other state banks remained open. The author was given access to the regular call reports and to the examiner's reports made to the Michigan State Banking Department by each of the 163 state banks which

failed during the period chosen. The reports were utilized to give summary data appropriate for the analysis of the conditions of failure. Although this special information was scarcely broader than that published for national banks in the country as a whole, it does indicate a commendable effort on the part of the author to improve the basic facts at hand for the diagnosis of the causes of failure of the Michigan state banks. Failures were related to size of city, size of bank, ratio of invested capital to gross deposits, liquidity measured by selected items, investment in real estate mortgages, diversification of assets, and profits and losses of the banks.

It is ironical that the study covers only one defunct Detroit bank; all others escaped inclusion because they were national banks, they were taken over by other banks, or they were supported until the time of the Michigan bank holidays. Nevertheless Detroit will long be remembered as the major storm center—especially, no doubt, by the officials of the Reconstruction Finance Corporation.

Much of the author's analysis is built around a comparison of the failed Michigan state banks outside Detroit with all national banks or all country national banks in the United States as a whole. At times, of course, no other comparison is possible, but surely when data for solvent Michigan state banks outside Detroit are obtainable they should be given preference over the data for all national banks, many of which failed during the period. When it was found, for example, that the ratio of capital investment to gross deposits of failed state banks outside Detroit was practically as favorable as that of solvent state banks outside Detroit the emphasis was shifted to a comparison with all national banks in the country (pp. 114 and 115). One should observe that the solvent Michigan state banks outside Detroit had a smaller ratio of capital funds to gross deposits than all national banks in the country as a whole (10.96 per cent against 14.78 per cent), even though part of the national banks failed. Results of this nature cannot be reconciled with the author's presumption that a difference of three or four points in the percentage of capital funds to deposits is a matter of consequence in maintaining solvency. Perhaps this negative evidence should lead to a modification of the time-honored view that a small percentage alteration of capital funds results in appreciable change in the strength of banks. How much added support does a four-point increase in the percentage of capital funds to deposits provide in the face of a 50 per cent liquidation of deposits? A few assets eligible for rediscount with the Federal reserve bank may be more important. In making the hybrid state-national bank comparison, it should be observed that all national banks were members of the Federal Reserve System; most state banks were not members.

The ratio of real estate mortgages to savings deposits is not a good measure of lack of liquidity even though one concedes that the mortgages become frozen easily. Banks fail as units. Both savings and demand deposits are involved, and demand deposits are the more variable of the two items. Using the ratio of real estate mortgages to savings deposits as a criterion, the author finds that failed state banks were more liquid than solvent state

banks (p. 123). A comparison of the mortgages with gross deposits, however, would have given opposite results.

The author's liquidity measure relates mostly to United States Government obligations (p. 119). He recognizes that open-market commercial paper, bankers' acceptances, call loans, and possibly customers' loans eligible for rediscount might be included if the data permitted. The failed Michigan state banks were definitely less liquid than national banks in the sense that they held fewer Federal issues. No mention is made of the practice of the Treasury of favoring national banks in the marketing of its obligations. Furthermore, is the measure as it stands shorn of other liquid items of much significance? Would banks be fully liquid if they were to become little more than Government bond trusts? Were the banks non-liquid before the War when there were almost no Federal obligations for them to hold? Will they be forced to become non-liquid when (no date will be set!) the Federal Government is able to reduce its debt to a nominal figure? The holder of Government obligations of anything more than short-term maturity must take his chances on the market. When the banking crisis was at its height many of the Federal issues were selling in the 80's. Liquidity of these premier securities was therefore far from perfect for those state banks which could not use them as a basis for rediscount.

Another criticism may be directed to a tenacious dependence on a small number of cases in some classes or groups of classes of banks. When a change in less than a half-dozen cases is sufficient completely to reverse interpretations, there is a strong likelihood that either pure chance or arbitrary control may condition the results. Apart from the question whether it is socially desirable to have banks small, middling, or large, it should be noted that the mortality rates for different sized banks have different meanings when interpreted in terms of the basic soundness of the institutions. The figures undoubtedly contain biases. The author's statement that "the experience of Michigan state banks during the depression supports the widespread belief that small banks are more vulnerable than their larger competitors" (pp. 111 and 112) is open to serious question. When the Michigan state banks were arrayed in terms of total resources there was a progressive reduction in the mortality rates with increases in size, it is true, but the banks in the highest class were by no means of a universally hardy variety, and failures among the medium-sized banks were nearly as frequent as those among the smaller banks. In terms of capital funds the smallest banks fared better than the average. Banks with capital and surplus of $25,000 or less had a better record than those of any other group except the banks with capital and surplus of $100,001 to $250,000 and $500,001 and over. Moreover, an addition of only three failures to the highest group would have given it an unfavorable comparison. Was it the condition of the small, medium-sized, or large banks in Michigan which induced the Governor to become exceedingly commemorative after Lincoln's birthday in 1933?

In view of the lack of positive evidence, the most that can be said is that until there is some way of knowing the effect of the varying availability of central reserve credit, the relation of the psychology of runs to the size of

the bank when there was no Federal deposit guarantee, the pressure exerted in the time of stress to save those banks whose failure would have completely shattered public confidence, and the incidence of mergers in saving banks on the brink the author has no safe basis for assuming that Michigan state banks of any particular size should bear more of the blame than those of any other size.

WILBERT G. FRITZ

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Financing Security Trading, by William M. Blaisdell. Philadelphia, Pennsylvania. Published by the Author. 1936. 199 pp.

This book contains a series of statistical and analytical studies of the financing of stock market trading in New York, London, Paris, and Berlin. The author seeks particularly to evolve a number of statistical indices that would measure both the volume and the velocity of turnover of funds required to finance the exchange of securities on these major financial markets. Considering the paucity of data, particularly on the European exchanges, his results are creditable. Several lines of investigation attempted, such as the computation of an index of the "floating supply" of securities on the New York Stock Exchange, are pioneer efforts.

The statistical problems involved in a study of the use of funds in security trading are given more adequate treatment than the theoretical background, which tends to be fragmentary and obscure. The author refrains from passing judgment upon the regulation of security loans provided by the Securities Exchange Act of 1934 and the Banking Act of 1933 but does find that "from the point of view of the banking system, the powers given to the Federal Reserve Board and the Securities and Exchange Commission should certainly be sufficient to acquire all the statistical information necessary."

The theory of the effects upon the outstanding volume and velocity of turnover of outstanding bank credit of security market conditions must be clearly formulated before it is feasible to determine the character of statistical data needed for intelligent study and regulation of the capital market. Mr. Blaisdell's book does not develop sufficiently such a background. The theoretical discussions suffer also from a lack of clarity in definition of such fundamental concepts as "savings" and "deposit turnover," which are of first-rate importance in any analysis of the use of credit in the security markets.

JULES I. BOGEN

The Journal of Commerce
New York City

Iron and Steel Companies in Years of Prosperity and Depression, by Herman Hollis Chapman. Tuscaloosa, Alabama: Author. 1935. xx, 316 pp. including 47 pages of appendix.

This work represents an approved thesis for the doctor's degree in Columbia University. No theory of the business cycle is presented here. Instead

Dr. Chapman studies the business cycle inductively by making a detailed analysis of the financial statements of the large iron and steel companies to ascertain how this industry, in its accounts, reacts to business fluctuations. As an accountant, he frankly admits the difficulty of making valid comparisons among statements of a given concern over a period of years as well as the lack of comparability of reports among different companies. The study covers the major cycle of 1914–1921 and that portion of the present cycle which falls before 1931.

The computations of the familiar financial ratios are made for a total of thirty-eight companies covering from 60 to 85 per cent of the industry's capacity. These are brought together into a representative figure for the industry by aggregating the figures for all the companies and then computing the percentage ratio. This method gives weight to the variations in accordance with the size of the concern. The arithmetic averages of percentage ratios, which give greater weight to the variation of individual concerns, are also computed in a number of cases. These computations are placed in an appendix for those who wish to follow a line of analysis free from the smothering effect of a few large corporations in the aggregative method. Because of the dominating position of the United States Steel Corporation, its ratios are often computed separately and compared with the results obtained from the records of the other companies. Either of these procedures leads to easy generalizations, and it must not be lost sight of that many diverse and conflicting tendencies are often hidden.

Important items in the financial statements, such as current assets, cash, receivables, inventory, current liabilities, marketable securities, fixed assets, common stock, preferred stock, funded debt, surplus, reserves, sales, gross and net profit, depreciation, dividend disbursements, reinvested earnings, and interest charges, are analyzed separately and in comparison with each other. It was found that the following major trends existed throughout the period: (1) continuous expansion of productive capacity represented by increases in fixed assets, in proprietorship, and in investment in securities; (2) the building up of a vast capital fund by corporate saving, which had the double effect of increasing assets and reducing debt; (3) the concentration of production within a smaller number of companies exclusive of the United States Steel Corporation, whose relative position declined. An analysis of sales, costs, production, and profits shows that in the steel industry "the peak was reached after a sharp and continuous rise in 1915 and 1916 and the descent was accomplished more slowly and after an interruption in 1920. The second [cycle] had a more prolonged rise which was temporarily halted by the minor recessions of 1924 and 1927, and the descent in 1930 and 1931 was sharp and continuous." The industry reached a much higher peak of prosperity during the rising prices of the War period than was reached in the years 1923–1929 despite the greater volume of production in the later period. The price level for steel products declined much more rapidly in the post-War period than did general commodity prices or wages.

The author finds that a series of indices—total current assets, current

liabilities, sales, and profits—distinctly reflect both major and minor business fluctuations, whereas others—inventories, interest and dividend payments—reflect only the major cycles. Some indices—the turnover of inventories into sales or the current ratio—anticipate basic changes in the cycle, whereas others—depreciation and dividends—show a definite lag. It is interesting to note that over the seventeen-year period ending with 1931 the average percentage of change—increases and decreases—in the aggregate value of the sales and of the aggregate amount of net profits was relatively less for the United States Steel Corporation than for the remainder of the industry.

In evaluating the work the reviewer finds it to be an excellent pioneering study of a single industry to see what light it can throw upon cyclical variations. Before we can go far in this line of financial analysis, however, accountancy must become standardized. The book is marred by some repetition and could be improved by the insertion of some graphs to illustrate the statistics. It is questioned whether the statistical deflation of the index of the dollar volume of profits by a wholesale price index leads to any usable results in comparing the relative prosperity of one period with another.

PAUL L. HOWELL

Cambridge, Massachusetts

Labor in Colonial New York, 1664–1776, by Samuel McKee, Jr. New York: Columbia University Press. 1935. 193 pp. $3.00.

This pleasant volume considers successively free labor, apprenticeship, indentured servitude, and slavery. It is based upon extensive and ingenious inquiry in original sources and is composed with an excellent gift of condensation. The subject is made realistic by constant brief quotations from advertisements, correspondence, courts decisions, and contemporary historians and chroniclers.

The author portrays the gradual dilution of indentured servitude and slavery in favor of free labor. The story shows, more than anything else, the importunate demand of a new and rich region for workers. At the same time, there was not always enough work for the skilled immigrants that came to the colony, so that these complained of the number of Negro slaves who were taught trades.

Many will find the treatment of slavery the chief contribution of the study. The proportion of slaves was of course smaller than in more southerly colonies, but, despite this, they were treated with suspicion generally and with shocking cruelty when there was any hint among them of plotting or rebellion. Dr. McKee is probably correct in feeling that one reason for suspicion was the readier assimilation of the imported Negroes in the staple agricultural system of the tobacco, rice, and cotton districts where the whole economy rested upon their labor. Also, the legal oppressions of the Negro slaves in New York were as much due to the fears of the whites, as to the bewilderment and recalcitrance of the blacks.

In a good many places the reader wishes that Dr. McKee had been able to sharpen the picture. He says several times that slave labor was more costly than that of freemen. One would like to have careful comparison of wages with maintenance, and some notion of the relative productivity of the types of workers. Also, the author's range of vision is not always wide enough. There might be more references to the sorts of labor treated in other colonies. Sometimes the European background of masters and servants is too summarily stated. Occasionally the text takes on the character of a page of classified want ads; this, in itself, is attractive, but want ads are in their very nature laconic and bring up more questions than they answer. Dr. McKee's material relates more to New York City, Albany, and a few other towns and settlements than to the farming districts of the colony. Although this fact makes the treatment unbalanced, the information about indentured servitude and slavery in towns is welcome because other authors have frequently neglected this important side of the question.

The book gives promise of more good work in economic history by this author. The reviewer wants to commend the total lack of pedantry and the admirable simplicity and clearness which mark Dr. McKee's presentation.

BROADUS MITCHELL

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Forest Taxation in the United States, by Fred Rogers Fairchild and Associates. Washington, D. C.: United States Department of Agriculture. Miscellaneous Publication No. 218. October, 1935. 681 pp. 75 cents.

This is the final report of the Forest Taxation Inquiry, established in 1926, the impressive results of ten years of study and research by many experts in taxation and in forestry, under the direction of Professor Fairchild, pioneer investigator and outstanding authority on forest taxation. In its accuracy and completeness, its scholarly analyses and judicious weighing of various factors in the problem, this report sets a very high standard indeed; and it should not only serve to guide state and national policies with respect to forest taxation, but should stand as an example of the care, patience and unhurried deliberation which should be more common in economic research.

This report covers not only the specific subject of forest taxation but the entire fiscal system of national, state and local governments; and the problem of forest taxation is discussed in its relation to other taxes and fiscal needs. The general property tax, as usual in treatises on taxation, receives much attention and the customary criticism. The report emphasizes the fact that while taxes on forest lands are not always seriously burdensome, and are not the only or even the chief reason for timber cutting and failure to reforest cut-over lands, yet forest lands, particularly cut-over and young forest lands, are often unfairly burdened because they yield a deferred return; and timber owners must pay taxes for many years during which they have no income. Several tax schemes, modifications of the general property

tax, are suggested to relieve forest lands of their unfair burden: the adjusted property tax, the deferred timber tax, and the differential timber tax.

A reading of this report, excellent as it is, stirs in the reviewer no strong hope of an early solution of our forest problem. When our enterprising forefathers turned forest lands over to private ownership they left for us a nearly insoluble problem. Even if legislators had the patience and training to read such a report as this, and to draw up tax laws in accordance with its recommendations, modification of the tax laws would not solve the problem. The solution, if there ever is any, will probably have to be found in vastly enlarged Federal and state forests.

JOHN ISE

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Vacations with Pay for Wage Earners. (N.I.C.B. Studies No. 215.) 1935. 35 pp. $1.00.

Wanted: Skilled Labor. (N.I.C.B. Studies No. 216.) 1935. 37 pp. $1.00.

Financial Incentives—A Study of Methods for Stimulating Achievement in Industry. (N.I.C.B. Studies No. 217.) 1935. ix, 47 pp. $1.50.

Women Workers and Labor Supply. (N.I.C.B. Studies No. 220.) 1936. xi, 42 pp. $1.00.

What Employers Are Doing for Employees—A Survey of Voluntary Activities for Improvement of Working Conditions in American Business Concerns. (N.I.C.B. Studies No. 221.) 1936. xiv, 70 pp. $2.00. New York: National Industrial Conference Board

Of the five related studies issued by the National Industrial Conference Board between April, 1935, and March, 1936, three are of interest chiefly to personnel and industrial managers, and the other two are of significance to any who are concerned, whether as statisticians or employers, with our labor supply.

The first, third, and fifth deal with vacations, financial incentives, and a comprehensive survey of personnel activities; the two of more general interest, with the dearth of skilled labor in the metal manufacturing industries and with women workers.

The monograph dealing with vacations traces the destiny of most of the 281 plans for wage earners that were known to exist in 1931 and of a baker's dozen started since 1932. Half operated continuously throughout the depression (assuming it now to be at an end), and another 10 per cent were discontinued but later reinstated. Over a third were discontinued—a fact not to be wondered at when one considers that vacations with pay cost about as much as all the other personnel activities combined. The relative scarcity of these plans for hourly workers is likewise traceable to their expensiveness.

The study of financial incentives indicates that the same percentage of

some 700,000 wage earners (44 per cent) were paid on some incentive basis in 1935 as in 1924. The significant change has not been toward or away from incentives, as has been thought by superficial observers, but in the drift from piece work to one of the premium and bonus systems. Doubtless, an important reason has been the sales effort of certain firms of management consultants. The weakest part of this report is that dealing with employee attitudes. Obviously, these cannot be accurately obtained through reports from employers.

Study No. 221 is perhaps the most comprehensive of the studies made to date of the "voluntary" activities undertaken by employers for their employees. The sample includes 2,452 companies and 4.5 million employees, of whom over half are in companies employing more than 10,000 workers. As Dr. Virgil Jordan points out in his foreword, this survey brings out the accomplishments of American enterprise that tend to be overshadowed, at least in the amount of news space, by the activities of government. For students of industrial relations, this is a very worth-while volume that is all the more useful because of its brevity.

The report dealing with skilled metal workers is less satisfying than the others, at least with respect to its statistical evidence. It estimates a 25 per cent reduction in highly-skilled labor since the onset of depression and reports a lack of skilled toolmakers and others by 35 per cent of the companies reporting.

The analysis of the relation of women workers to our labor supply is an an interesting and effective answer to the questions one hears discussed endlessly concerning unemployment. It shows what, of course, anyone could have found from the Census data, that there were more workers per million of population, 10 years of age and over, in 1930 than in 1880 (495,000 vs. 473,000 to be exact). But during this period, the number of men gainfully employed per million inhabitants declined 15,000; the gain in the total came from the influx of women, chiefly into the distribution and service industries. In fact, the number of women in gainful occupations quadrupled in comparison with a population increase of 145 per cent.

This gain in the percentage of population gainfully employed is attributed both to shorter hours and to the diversification of human activities associated with a higher standard of living. The second of these reasons is supported by the percentage distribution of workers in production and in distribution and service industries. The percentage in production declined between 1880 and 1930 from 75 per cent to about 53 per cent, whereas the proportion in distribution and service industries rose from 25 per cent to 47 per cent. The study concludes that there is little evidence of women having encroached upon male occupations. Rather, it attributes the increase to the inability of the male population to meet the increased demand for labor resulting from the development of services. The report also summarizes the state figures on the unemployment of men and women between 1929 and 1935. Women suffered less severely than men, and the report observes that the service occupations in which women predominate declined less and at a

later date than the productive industries. It concludes that the employment of women has not injured the male population.

Although one may agree that this is an answer to the silly talk of a few years ago concerning the firing of married women, it still does not get to the bottom of the social problem involved. Though no one quarrels with the gainful employment of married women who have others really dependent upon them, there must often be a social loss when the wife runs an office instead of her home. Her money contribution to the family exchequer is at least partially offset by her lessened ability to make the most of her job of family spender and manager.

C. CANBY BALDERSTON

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Wheat Studies of the Food Research Institute (Stanford University).

"Japanese Self-Sufficiency in Wheat," Vol. XII, No. 3, November 1935, pp. 57 to 100. $.75.

"The World Wheat Situation, 1934–35, A Review of the Crop Year," Vol. XII, No. 4, December 1935, pp. 101 to 182. $1.00.

"World Wheat Survey and Outlook January 1936," Vol. XII, No. 5, January 1936, pp. 183 to 220. $.50.

"The Stale-Bread Problem," Vol. XII, No. 6, February 1936, pp. 221 to 247. $.50.

"Canadian Wheat Stabilization Operations, 1929–35," Vol. XII, No. 7, March 1936, pp. 249 to 271. $.50.

"New Data on United States Flour Production Since 1899, By States and by Sizes of Mills," Vol. XII, No. 8, April 1936, pp. 273 to 312. $.75.

"World Wheat Survey and Outlook May 1936," Vol. XII, No. 9, May 1936, pp. 313 to 338. $.50.

"World Wheat Utilization Since 1885–86," Vol. XII, No. 10, June 1936, pp. 339 to 404. $1.00.

In one sense, these eight monographs cannot be reviewed as a single study. They deal with quite different aspects of the many problems associated with world wheat production and consumption. In another sense, however, they support each other and do form parts of a complete study. It must be kept in mind, however, that they are but eight chapters in a long series and are not arranged in any logical order as would be the case in a finished book.

Three of these monographs deal with the world wheat situation from 1934 to the spring of 1936 (Numbers 4, 5, and 9). It is pointed out that during the 1934–1935 season world wheat stocks were reduced from a record peak in the midsummer of 1934 and reached halfway towards normal levels by

August, 1935. A considerable part of the carry-over remaining at that time was held in Canada as a result of price-supporting operations there. International trade in wheat during 1934–1935 was at its lowest level since the War. Exports from the United States particularly were curtailed; in fact, the United States was a net importer for the first time since 1836–1837.

It was pointed out that another short world crop in 1935 suggests still further reduction in carry-over. Since these studies were issued, crop conditions in North America in 1936 have proven to be bad, and, as a result, the winter of 1936–1937 will probably show a very important reduction in stocks in all countries. No basic solution of the wheat surplus problem seems to have been found, however. Wheat consumption for food remains low, and growers seem still prepared to produce more than world markets will absorb at prices that are satisfactory to the growers.

Perhaps the prolonged drouth of 1936 may result in a semipermanent reduction of wheat acreage in certain parts of North America. At least, the drouth situation, coupled with the continued likelihood of surplus production, raises some very important questions in social policy.

It is pointed out in Bulletin Number 5 that one of the principal factors in the world wheat situation is the control of Canadian wheat supplies exercised by the Canadian Wheat Board. Bulletin Number 7 is devoted to an analysis of the Canadian wheat stabilization operations during the period 1929 to 1935, inclusive. This bulletin is introduced by a comparison of American and Canadian developments with special reference to the activities of the Federal Farm Board and the Farmers' National Grain Corporation in the United States. It is pointed out that these organizations as well as the Canadian organizations are experiments in marketing on a very large scale. They should furnish some answer to certain basic questions. Among these questions are the following:

1. Can a market operator, financially strong, bend the price at will and make it turn in the direction he wishes it to take?
2. Can such an operator negatively block or divert any major trend of prices resulting from the play of regular market forces?
3. To what extent and under what conditions can he either positively or negatively influence price fluctuations and temporary movements?

Unfortunately, there is no practicable way to develop final answers to these questions. The factual material regarding wheat pool purchases, sales, and holdings, and regarding both Winnipeg and Liverpool prices, is presented both tabularly and graphically. Their apparent implication is discussed in some detail. The general conclusion is suggested that the experience of both the Federal Farm Board and the agency in Canada answers the first two questions definitely in the negative. Even in the case of the third question, it was found that the immediate reactions of price to the impact of buying and selling by the Canadian agency were surprisingly few. In other words, the tentative conclusion of this study is to the effect that large-scale governmental operations of the sort undertaken in the United States and

Canada can have no far-reaching effect on quantity-price relations. One appears to be forced back to the conclusion that, when prices are below those considered remunerative by the producer, the only relief lies in a reduction of the quantity produced.

As other illustrations of world developments in wheat production, Bulletin Number 3 deals with Japanese self-sufficiency in wheat. In this study it is concluded that Japan will probably require between 53 million and 63 million bushels of wheat annually. This volume of wheat she is capable of producing; consequently, she is not likely to import much wheat for domestic use, excepting modest amounts of strong wheat. She may continue to import additional wheat to mill for export, provided she can hold the flour markets of China, Manchukuo, and other eastern markets. The more basic question that is raised in this particular study is that of possible integration of commercial policy on the part of Japan. Japan appears to be, like the United States, attempting to ride two horses at the same time. That is, she is trying to develop a constantly broadening export market for manufactured goods and at the same time to make her production of agricultural raw materials self-sufficient. Up to the present time, Japan has been a net importing country, and consequently some curtailment of agricultural imports is permissible without interference with her export trade. On the other hand, any material increase in exports will require a maintenance or even increase in her imports in order to balance trade. The question must fairly be faced as to whether such imports will be forthcoming when Japan is self-sufficient in foodstuffs. Perhaps England faced this problem more realistically and fairly when she repealed the Corn Laws in order to permit the development of manufacturing for export.

Bulletin Number 8 discusses the production of flour in the United States from 1899 to 1935. Several important contributions are made. In the first place, it is interesting to note that the total production in 1933 and 1935 was approximately the same as in 1899. From the latter date, production increased to a maximum in 1919 when it was about 30 per cent higher than in 1899. Following the War, there was an abrupt drop of some 20 million barrels a year. This was followed by a few years of increase, reaching a new peak in 1929, some 18 per cent above the 1899 figure. During the depression, milling fell off materially and remained approximately stationery from 1933 to 1935. In the second place, it is interesting to note the change in proportion of milling done in mills of different size. In 1899, approximately 40 per cent of the total flour output came from large mills. This increased to 80 per cent in 1929 and has remained at approximately that point during the depression. The inquiry may, perhaps, be raised as to whether any further movement towards large mills will take place. This is perhaps a good illustration of the practical limits in the advantages arising from large-scale production. One wonders whether in most industries there are not opportunities for organizing production in plants of very different sizes with approximately the same cost. In the third place, it is pointed out that there are some important geographical differences in the proportion of large and small mills. In Minne-

sota and New York, particularly, the large mills dominate the industry. In the Kansas City area this is less distinctly true. Moreover, throughout the soft wheat districts there is a larger proportion of small mills than in the hard wheat milling districts. In a few of the soft wheat states, more than 50 per cent of the output still came from small mills in 1931.

In Bulletin Number 10, there are presented a great many new data concerning world wheat utilization over a long period of years, beginning with 1885. Both total use and per capita consumption are discussed in detail. It is particularly interesting that the United States is the only section of the world included in the study which did not show a continuous upward trend in per capita consumption up to the time of the World War. In contrast, there is no part of the world that has shown a per capita increase in any regular or continuous way since the War. Further, it is interesting to note that per capita consumption in the United States was distinctly higher than in other parts of the world until about 1905, at which time the consumption of western Europe and of the other larger exporting countries approximately equalled that of the United States. Since the War, per capita consumption has been definitely lower in the United States than either in western Europe or in the other principal exporting countries. This is associated, perhaps, with the increasing general standard of living in the United States and also with the increase in sedentary occupations.

There remains for mention only Bulletin Number 6, which is entirely different in character from the others included in this review. This bulletin deals with the stale bread problem in the United States. It starts with a brief consideration of the economic and social questions involved, but it deals primarily with the chemical and technical considerations. It is pointed out that the problem arises as a natural accompaniment of large-scale bakeries with distribution of bread from a single plant throughout an extended geographical area. Unless the waste due to staleness is minimized, it is likely to more than offset any advantages that attach to large-scale baking operations. The technical suggestions made in this study should prove of real value to the industry as well as to consumers through the reduction of the conditions that produce unusable, stale bakery products.

All these studies appear to be carried out with the usual thoroughness of the Food Research Institute. The series is rapidly giving us the most complete picture that is available of any single industry or series of related industries. Similar detailed information regarding other industries would be of great value. Although the general excellency of the wheat studies is high, still I cannot refrain from one broad criticism. It seems to me that many of the graphs that are used miss the full possibility for usefulness. Some of them are too complicated to be easily interpreted, and others are either misleading or fail to fully illustrate the point at hand. For example, Figures 1, 2, and 3 in Bulletin Number 7 on the Canadian wheat stabilization operations are, it seems to me, much more complicated than necessary and very difficult of actual visual comparison. The attempt is made in these figures to illustrate the effect of wheat pool policies on Winnipeg and Liverpool prices.

If the data could have been broken down into three or four separate graphs, it seems to me that the desirable comparisons would have been clear, whereas in the present form, it takes the proverbial Philadelphia lawyer to discover the comparison. As a second illustration, Figure 6 in Bulletin Number 10, on World wheat utilization, might well have been produced on a vertical log scale. This would have made possible visual comparisons of the rate of increase in utilization in the various parts of the world. Such a comparison is impossible from the graph as it stands, and yet that seems to be the main purpose for a presentation of the data in graphic form. Other illustrations of both of these two types of shortcomings could easily be mentioned.

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A Handbook of Social Statistics of New Haven, Connecticut, Yale University, Institute of Human Relations. New Haven: Yale University Press (Photoprint). 1936. Compiled by Thelma A. Dreis. xiii, 146 pp. $2.50.

This excellent handbook represents for New Haven the same kind of systematized and basic information by wards that has in recent years been compiled for a large number of cities by census tracts. There are also some special features. It contains the usual analysis of population composition, economic and social status, and vital statistics drawn from the Census figures and state registrations. These are depicted on maps and in tables. In addition there are analyses of (1) professional leadership by wards, data for which has been drawn from *Who's Who* and various local directories; (2) juvenile delinquency distribution; (3) unemployment relief; (4) an interesting study of population mobility on the basis of applications and removal orders for gas meters; and (5) a sample study of about one-twentieth of all families with respect to (a) crowding, (b) size of family by nationality of head, (c) types of families (six-fold classification on the basis of composition), (d) income, (e) education, (f) religious preference, (g) unemployment, and (h) families known to relief agencies. The sample study, which yielded much information not available except through interviews, was selected by taking one in every twenty families from the gas company's residence files, supplemented by families in apartment houses. The full procedure is not described, but there are good reasons for regarding it as reliable. The handbook will be invaluable to local business administrators, government officials, and social workers. It is of more than local importance in its contribution to the growing body of information on the ecology of cities and in some of its methodological suggestions. It is excellent for its brevity, clearness, and total absence of "padding" with trivial "case" material, irrelevant history, and elaboration of the obvious. A street address index adds greatly to the practical usefulness of the handbook to future studies.

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I. *Handbook for the Collection and Tabulation of Statistical Information about Children in Foster Care by the New York State Department of Social Welfare:* Presented by the Division of Research, Division of Child Welfare and the Division of State Institutions, 133 pp.

II. *Handbook for the Collection and Tabulation of Statistical Information from Private Institutions for the Care of the Aged in the State of New York:* Presented by the Division of Medical Care, New York Department of Social Welfare, 56 pp.

III. *Handbook for Statistics of Mothers' Allowances:* Prepared by the Division of Research and the Division of Child Welfare, 24 pp. State of New York, Department of Social Welfare. Albany: J. B. Lyon Company, Printers. 1935.

Progress in reporting statistical data pertaining to social work was given a strong impetus when a demonstration project "for the development of comprehensive statistics of welfare administration" was undertaken by the New York State Department of Social Welfare. Clothed with the legal right to demand definite information on the operation of all agencies falling within their jurisdiction, the State Departments of Social Welfare are in a more fortunate position in their attempts to standardize comprehensive reporting procedures than are the "appealers and persuaders" of the Children's Bureau, private foundations, or national associations.

Cognizant of this fact the Division of Research of the New York State Department of Social Welfare, with the financial assistance of the Spelman Fund of New York and the cooperation of an advisory committee on research headed by Ralph G. Hurlin, carried out an extensive three-year program in connection with the demonstration project. As a part of this project the Department of Social Welfare published a series of handbooks for collection and tabulation of statistical data in the various fields of social work. The three brochures that are subjects of this review are a part of this series.

The series of handbooks is of interest primarily to persons engaged in field work related to the registration of social statistics. The sets of forms suggested in the handbook for recording of data contain several additions and slight deviations from the forms used by the Children's Bureau, but instructions for filling out these forms are more detailed and more carefully worded. The first two handbooks give also an outline of a set of tables to be prepared for a comprehensive analysis of the selected data.

The implied appeal of this series is by far more significant than its particular contents. It is an appeal to the welfare departments of other states to profit by their strategic position and attempt on a statewide scale to standardize reporting procedures in social welfare work. The New York State Department of Social Welfare blazed the way. Will welfare departments of other states follow the lead?

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